SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING, Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; CHARLES D. WALCOTT, Geology; W. M. DAVIS, Physiography; HENRY F. OSBORN, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; C. E. BESSEY, N. L. BRITTON, Botany; C. S. MINOT, Embryology, Histology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; WILLIAM H. WELCH, Pathology; J. MCKEEN CATTELL, Psychology; J. W. POWELL, Anthropology.

FRIDAY, JULY 19, 1901.

CONTENTS:

A Century of Civil Engineering: DR. J. JAMES R. CROES 83
The British National Antarctic Expedition 94
Teaching Chemistry in Schools: DR. RUFUS P. WILLIAMS 100
Scientific Books:—
Turneaure and Russell on Public Water Supplies: PROFESSOR MANSFIED MERRIMAN. *Willey's Zoological Results:* DR. G. H. PARKER. *Lühe's Ergebnisse der neueren Sporozoenforschung:* DR. C. W. STILES 104
Scientific Journals and Articles 107
Societies and Academies:—
Physics at the American Association. Section of Biology of the New York Academy of Sciences: PROFESSOR HENRY E. CRAMPTON 108
Discussion and Correspondence:—
The Washington Memorial Institution: DR. W J MCGEE. *The Royal Society of Canada:* DR. H. M. AMI. *A Horned Lizard at a High Altitude:* PROFESSOR T. D. A. COCKERELL 111
Shorter Articles:—
The Geologic Distribution of Pollicipes and Scalpellum: DR. F. A. BATHER 112
Quotations:—
The Salaries of Scientific Men in the Employment of the Government. The National University Project 112
A New Mammalian Genus 114
The New Bureau of Forestry 115
Scientific Notes and News 116
University and Educational News 119

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*A CENTURY OF CIVIL ENGINEERING.**

THE century which has just passed, the nineteenth of the Christian era, is distinguished from any of the preceding hundred-year periods in the world's history by the advances made in the cooperation of investigators in numerous branches of science in the formulation of doctrines regarding the nature and coordination of natural phenomena, which stand the test of experiment and calculation, thus leading to a nearer approximation to the understanding of the laws which govern such phenomena, and so to the development into a profession of the 'Art of directing the great sources of power in Nature for the use and convenience of Man,' which Art is entitled Civil Engineering. This definition is itself one of the most noteworthy products of the Nineteenth Century, and a study of the sequence of events and reasoning which led to its formulation is not without interest.

Ever since man became endowed with consciousness and the power of reasoning, he has been striving to solve the problems of the physical world around him in which he perceived matter in motion, which was evidenced to his senses by sight and touch, by sound and taste and smell, but which was devoid of sentience, so far as he could

*President's address before the American Society of Civil Engineers at the Annual Convention at Niagara Falls, N. Y., June 25, 1901. *Transactions* Am. Soc. C. E., XLV., 599.

discover. He observed at once that by its different manifestations his physical comfort was materially affected, and it did not take long for him to learn that certain sequences of sensation, of one sort or another, followed certain manifestations occurring singly or in combination, and then that the order of many such manifestations could be controlled by him at will, while that of multitudes of others could not be so controlled at first, their methods and causes not being appreciable by his unassisted senses.

But until about three hundred years ago there does not seem to have been any systematic and well-directed effort to investigate the reasons why material changes occurred naturally, or how certain changes could be artificially produced with certainty.

To discover the sequence of natural events is first of all an empirical task: facts must be observed systematically, and recorded, and then their combinations reasoned upon. Hypotheses can then be formed as to the probable effects of slightly different collocations and sequences of events, and these subjected to experiment and computation. An hypothesis cannot be established as a scientific fact until it has been verified by observation and also proved to be in accordance with mathematical laws. Tennyson's apothegm, that 'knowledge comes, but wisdom lingers,' is profoundly true.

Now, up to the beginning of the seventeenth century of the Christian era, there had been no organized physical experimentation, on a comprehensive scale, and intelligent reasoning therefrom. The speculations as to the laws of nature which had been made from time to time had been purely efforts of the imagination, and were unsustained by either practical demonstration or analytical reasoning. Various hypotheses had been framed, on insufficient or incorrect premises, and some of them had been so near the truth as actually to delay the progress of the truth, by the appearance of exactness in the reasoning from them, up to a certain point.

Really, the civil engineer had been practicing his art and directing the forces of nature for the use and convenience of man, but without any conception of what those forces were, or how they acted, or of why he did anything, or what the result of it would be, unless he had done the same thing before in the same way. He did not know that the earth moved, and he had no idea why or at what rate a stone fell to the earth, or water ran down hill. He had no measure of heat or light, and used no power but that which the muscles of an animal produced. And yet he had built the Pyramids, the Parthenon and the Pantheon; had constructed aqueducts, canals and sewers; had regulated and maintained the rivers of China for thousands of years; and had just been recognized, on account of his labors in protecting the lowlands of Holland and the shores of Italian rivers from the encroachments of the water, as holding a distinct rank among the workers of the world.

Of the application of the forces of nature to aiding his labors, he seems to have been ignorant, except by the use of a flowing stream to turn a wheel. The earliest recorded application of this mode of producing power in England was in 1582, when Peter Moryss, a Hollander, procured from the City of London a franchise for five hundred years for supplying water to the city by pumping from the Thames, using a wheel driven by the ebb and flow of the tide under London Bridge.

With the beginning of the seventeenth century, the world entered on a new era of science, theoretical and applied. The casual observation by a little child of the curious optical effect obtained by looking through two pieces of glass led to the invention of the telescope and the microscope, which

disclosed to man objects beyond the reach of his unassisted vision. The swinging of a hanging lamp suggested to a thoughtful man the idea of an unseen force, and Galileo, by experiment and reasoning, discovered the law of terrestrial gravitation and first grasped the idea of force as a mechanical agent.

Turning his newly invented telescope upon the heavens, he was the first man in the world to witness the actual motion of the planets and their satellites, and to prove that they and the earth revolved about the sun, as Pythagoras had imagined two thousand years before, Copernicus had asserted a hundred years before, and his own contemporary, Kepler, had reasoned from the imperfect data then possessed, and had actually formulated the laws of their motion in forms which the science of our day confirms exactly. He was the first to conceive the theory of transverse strains in solids, but the facility of experimentation with fluids diverted his attention from more rigid bodies, and the fundamental principles of hydraulic science were established by him and by his pupils and immediate successors in the fascinating studies he had introduced.

To Galileo also is due the invention of the thermometer, which enabled definite measurement to be made of the mysterious phenomenon of heat which his great contemporary philosopher in England, Lord Bacon, conceived to be 'an expansive undulatory motion in the particles of a body whereby they tend with some rapidity toward the circumference, and also a little upward.' But Bacon was two hundred years in advance of the physicists, and the century was occupied almost exclusively in the elucidation of the laws of gravitation as exemplified in the action of fluids. For the study of liquids and their action demonstrated that they were, under certain conditions of temperature, transformed into invisible and elastic substances governed in general by the same laws, and also that there were all around other similar substances which could not be condensed into liquid inelastic form, but could be weighed by the barometer which Torricelli invented in 1643. And so the laws of gases came to be investigated and formulated by Mariotte, who, to aid him in his researches, invented the rain gauge in 1677, and measured the liquids condensed from the atmosphere. The value of the data thus obtained, to the hydraulic engineer, was appreciated by the French engineers at once, and ever since 1681 records of the rainfall have been kept continuously at Paris, and the practice has gradually extended over the whole world. But it is worthy of note that fifty years after the invention of the rain gauge, Belidor, in his magnificent treatise on Hydraulic Architecture (1728), the first compendium of engineering theory and practice, in treating of the sources of water supply for domestic use, did not mention the rain gauge or the amount of rainfall, but dwelt on the divining rod as the recognized means of discovering subterranean streams of water.

The close of this century saw the final establishment of the law of gravitation by Newton's proof of its governing the whole material universe. And any review of the progress made during the century toward the understanding of the laws of nature would be incomplete without allusion to the two great steps taken in it toward the facilitating of mathematical computations, the invention of logarithms at the beginning of the century and of the calculus at its close.

That heat produced dynamic effects had been recognized for ages. That it destroyed some solids, that it converted others into different forms possessing entirely different properties, that it caused the dissipation and disappearance of liquids, were facts

well established. That by its application to certain combinations of materials an explosive effect could be produced which overcame the force of gravity had been discovered three or four hundred years before when gunpowder was invented, but that a mechanical effect could be produced by the use of heat was not understood, and the nature of the phenomenon itself was not comprehended. It was looked upon by physicists as an 'element' or primary form of matter, and in 1690 Stahl conceived the idea of 'phlogiston,' an elementary substance, invisible and inappreciable by the senses, which entered into the composition of combustible substances, and which, by the process of combustion, was separated from them and passed off in the form of corpuscules which, striking the sensory nerves, were perceived as heat. Sir Isaac Newton espoused this phlogiston hypothesis and also conceived that light was the product of certain corpuscules which were perceived by the optical nerves. The discussion of these hypotheses occupied the attention of the philosophers for the whole of the eighteenth century, and, in the meantime, the physicists were busy experimenting on the methods of utilizing the vapor into which heat converted water. By degrees, the steam engine was developed into a practical machine, capable of doing work which before could only be accomplished by animal labor, and the engineer availed himself of it in the handling of materials. But although the chemists had been striving for centuries to learn the composition of matter and the means of transforming and combining its several natural conditions, they had not, at the beginning of the nineteenth century, learned how to produce either heat or light, except by the aboriginal method of striking flint and steel together. In the lack of knowledge of the properties of these phenomena and the fact that they could be utilized on a large scale, there was no occasion for the devotion of any special class of men to their production and development. There were two other classes of phenomena which seemed as if they ought to be controlled by man, but the laws of which had so far eluded discovery—electricity and magnetism. So that, really, all that the civil engineer had to deal with was the force of gravity acting on such materials as the earth yielded him, in their natural state or as they could be modified by heat and manual labor.

But he had been making progress. In Italy, where the first application of science to construction had been made, the study of the laws of hydraulic science had been constantly pursued, and those laws applied to the regulation of the rivers; in France, ever ready to grasp new ideas and to pursue their application to practical results, the principles of hydraulics had been studied and applied to the construction of great canals, and to the supply of water to Paris, where, in 1671, water was pumped by a water wheel driven by the current of the Seine and distributed through cast-iron pipes. In England, Hugh Myddelton had supplied London with water, and, in 1638, Nicholas Vermuyden had been called in from Holland to protect the lands along the River Ouse from overflow, a task so well accomplished that his work stood for a hundred years, and only failed then from lack of proper maintenance, the English having by that time apparently concluded that, as Dr. Franklin wrote in 1772, 'rivers were unmanageable things,' and, inspired by the success of the public waterways of France, turned their attention to the construction of canals and the improvement of harbors. Many important works of this class were built in England during the last half of the eighteenth century. The men by whom these works were constructed were not educated men or men experienced in scientific research. They certainly were

men of great natural ability and good judgment, and capable of conceiving and executing great projects. One of the greatest of them, John Smeaton, who was the first Englishman to call himself a civil engineer, thus expressed his conception of the profession which he adorned:

"Civil engineers are a self-created set of men whose profession owes its origin not to power or influence, but to the best of all protection, the encouragement of a great and powerful nation, a nation become so from the industry and steadiness of its manufacturing workmen and their superior knowledge in practical chemistry, mechanics, natural philosophy and other useful accomplishments."

Smeaton was himself an investigator, but he is the only one of the civil engineers of Great Britain during the eighteenth century who strove to discover the laws which governed the operations of Nature.

The most eminent civil engineer in England in the year 1800 was Thomas Telford, who was born in 1757. Beginning life as a mason, he developed an extraordinary faculty of generalization, combined with an intimate acquaintance with the details of workmanship in all the methods of construction known in those days. In the building of canals, highways, harbors, bridges and docks he displayed great grasp of the subject of the improvement of transportation facilities, as then existing, and great boldness of design and ingenuity in construction.

But it must be borne in mind that at that time the canal was considered the only possible mode of increasing facilities of transportation and reducing cost, no motive power except animal force was known, the metals were but little used in construction, and a framed structure adapted to bear heavy loads was unknown. As 'an eminent mathematician,' quoted in the *Edinburgh Review* in 1805, remarked:

"While we give ourselves infinite trouble to pursue investigations relating to the motions and masses of bodies which move at immeasurable distances from our planet, we have never thought of determining the forces necessary to prevent the roofs of our houses from falling on our heads."

It is related of Telford that when on one occasion he was consulted by a young man as to the advisability of his engaging in civil engineering, he said to him: "I have made all the canals and all the roads and all the harbors. I don't see what there is that you can expect to do."

His ideas regarding the training of the civil engineer are given at some length in his Personal Memoirs prepared shortly before his death.

"Youths of respectability and competent education who contemplate Civil Engineering as a profession, are seldom aware how far they ought to descend in order to found the basis for future elevation. Not only are the natural senses of seeing and feeling requisite in the examination of materials, but also the practiced eye, and the hand which has experience of the kind and qualities of stone, of lime, of iron, of timber, and even of earth, and of the effects of human ingenuity in applying and combining all these substances, is necessary for arriving at mastery in the profession. For how can a man give judicious directions unless he possesses personal knowledge of the details requisite to effect his ultimate purpose in the best and cheapest manner?

"It has happened to me more than once, when taking opportunities of being useful to a young man of merit, that I have experienced opposition in taking him from his books and his drawings and placing a mallet, chisel or trowel in his hand, till rendered confident by the solid knowledge which experience only can bestow, he was qualified to insist on the due performance of workmanship and to judge of merit in the lower as well as the higher departments of a profession in which no kind or degree of practical knowledge is superfluous."

This is doubtless good, sound doctrine, but it does not betoken any very lofty conception of the aims and ends of the profession. But during the first quarter of the nineteenth century Telford stood at the head of the profession of civil engineering, and when, in 1820, the recently formed association of its practitioners for mutual advancement in science, which was termed the Institution of Civil Engineers, desired

a prominent leader, he was chosen its president, and held that office until his death in 1834. He does not appear to have contributed to the Institution any papers or discussions on engineering subjects.

Among the members of the Institution at that time was a man thirty years the junior of the president, who, like him, had risen from humble origin, and by his own exertions attained a high rank in the profession, and who, rather oddly, had the same forename, and a surname of two syllables, the initial and final letters of which and the vowel sounds of which were the same as Telford's. This similarity of name has led to some confusion and sometimes to the attributing to one of these men the sayings and doings of the other.

Thomas Tredgold, born in 1788, began life as a carpenter, but soon devoted himself to the study of engineering science and its practice in the office of the Chief Engineer of the Ordnance Bureau. He early recognized the deficiency of the knowledge then existing as to the nature and strength of the materials used in construction, and he studied, experimented and reasoned systematically, and published the results of his labors. His 'Treatise on Carpentry,' in 1820, was the first published attempt to determine scientifically and practically the data of resistance of beams to transverse flexure. During the next seven years he contributed to the *Transactions* of the Institution of Civil Engineers papers showing the mode of application of science to engineering problems, and he also published treatises on Warming and Ventilation, on Steam Navigation, on Railroads and Carriages, and on the Steam Engine. It was to him that the Institution turned when it wished to apply for a royal charter, in 1828, and requested him to prepare a definition of civil engineering.

As we look back upon the history of science, theoretical and applied, during the first quarter of the nineteenth century, we can see how a new definition of the profession of civil engineering was needed at that date.

At the very beginning of the century there had occurred a marvelous revolution in the conception of the nature and operation of the laws governing matter and its motion. Lavoisier had revolutionized chemical science and Dalton had propounded a theory of atomic constitution of matter which has been sustained by observation and reason. All matter is composed of a few primal elements in an atomic or minutely subdivided form. These atoms have varying chemical affinity for each other, and, combining in certain proportions, form molecules of matter of various kinds. The study of these combinations has been the business of chemists for the last hundred years, and the laws of combination have been so successfully elucidated that many forms of matter which before were found only in a state of nature can now be artificially produced, and many other forms have been produced which are never found in nature and which are useful for purposes and under conditions where no natural product can be used to advantage. The impetus given to chemical research by the formulation of Dalton's theory was sufficient to establish the fact, early in the century, that chemical affinity was a source of power which could be directed by man intelligently and with prospect of advantage.

Just with the incoming of the century, too, came Rumford's demonstration of the fact that heat was not a material substance, but only a mode of motion. Almost simultaneously was propounded the theory of Thomas Young, that light, too, was not material, but was simply due to vibratory motion in an all-pervading medium to which he gave the name of the luminiferous ether.

It was in 1800, too, that Volta demon-

strated that an electric current could be artificially produced. How it could be controlled and applied to practical use did not yet appear, but a new direction had been given to the minds of those engaged in physical research.

As it became manifest that chemical affinity and heat and light could be controlled and directed and converted into Energy, as Young termed it, the men who had been trained in utilizing the force of gravity turned their attention to the development of these newly understood sources of power. Fitch and Fulton, with the aim of reducing the cost of water transportation, succeeded in applying the steam engine to the propulsion of boats, and Trevithick made successful application of steam propulsion to vehicles on land. Murdock had proved that illuminating gas could be produced and distributed to consumers. The civil engineers of the day had seized on all these inventions and discoveries, and in both Europe and America were designing and constructing works to render them useful to the greatest number of people.

Reviewing then what had been accomplished during the first quarter of the century, Tredgold could not but perceive that civil engineering was something broader and more comprehensive than the mere construction of harbors, breakwaters and canals, and he presented on January 4, 1828, in response to the request of the Institution, this ever-memorable definition of civil engineering:

"Civil Engineering is the art of directing the great sources of power in Nature for the use and convenience of man; being that practical application of the most important principles of natural philosophy which has, in a considerable degree, realized the anticipations of Bacon, and changed the aspect and state of affairs in the whole world."

After a brief sketch of the objects of civil engineering, he added:

"The real extent to which it may be applied is limited only by the progress of science; its scope and utility will be increased with every discovery in philosophy, and its resources with every invention in mechanical or chemical art, since its bounds are unlimited, and equally so must be the researches of its professors."*

A more concise and comprehensive definition of a great truth can hardly be conceived. From a physical and intellectual standpoint, a nobler aim for the exercise of the mental powers cannot be imagined than the direction of the great sources of power in nature for the use and convenience of man. Psychology deals with mind alone, Physics considers the nature and the laws of matter, but Civil Engineering treats of the intelligent direction of the laws governing matter so as to produce effects which will reduce to a minimum the time and physical labor required to supply all the demands of the body of man and leave more opportunity for the exercise of the mental and spiritual faculties. Philosophy, Physics and Civil Engineering must work hand in hand. The philosopher must imagine, the physicist prove by experiment and mathematical computation, and the engineer apply to practice, the laws of matter. Each must keep himself informed of the progress made by the others and must aid them by suggestions as to the lines on which research needs to be carried forward. The civil engineer, in attempting to solve some problem of construction, finds that he needs a material which shall possess a certain quality which he cannot discover that any natural product possesses. He calls the chemist to his aid, and he, from a study of the combinations of existing forms of matter which most nearly approach the desired ideal, reasons that some special combination of elements will entirely fulfill the conditions, and he experiments to find whether such combination can be made. Sometimes he is successful in his first attempt and some-

* *Minutes of Proceedings*, Institution of Civil Engineers, Vol. XXVII., p. 181.

times not. But, whatever the result, he has added to his knowledge of the laws of combinations and has furnished to the philosopher fresh data for his generalizations, and to the engineer a new material for his use.

It not infrequently occurs that, from investigations made for a specific purpose, results are obtained of the greatest usefulness for an entirely different purpose. Thus, in 1855, when Henry Bessemer, inspired solely by that desire 'to kill something' which is alike the ruling passion of the rudest savage and the most highly civilized man, bent all his energies to the production of a metallic combination which should be able to resist the force of the highest explosive and so enable a cannon ball to be projected from a gun to a greater distance than ever before, he discovered a method of expelling all foreign substances from iron and then adding a minute quantity of another element, carbon, in such proportions that the original mass was materially changed in character and made more ductile, stronger and stiffer. The product was exactly what the railroad engineer wanted at that time for the bearing surface of his roadway, and the material which had been sought for destructive purposes became a most important factor in facilitating the transportation of men and goods with certainty and safety at high speeds.

As the knowledge of the nature of steel and the precise methods in which it can be manufactured have progressed, the engineer has gradually come to know just what he wants and how it can be produced, and, in his specifications, requires that the particular material of this class which he desires shall be of a certain chemical composition and also possess certain characteristics. The same is the case with almost every material which enters into the construction of engineering works of the present day. Matter in its original state is rarely used. Its chemical condition must be transformed before the engineer can utilize it with any confidence. That almost any desired transformation can be effected was not realized until late in the century. Starting with the atom, the ultimate particle of matter so far comprehended by us, the chemist found that several different kinds of atoms could be identified, and that these would combine in certain ways according to laws which could be formulated. But in the application of these laws and the tabulation of the results gaps were found to exist which could not be filled without the supposition that other elements existed than those already known. The existence of such elemental substances was confirmed by the revelations of the spectrum analysis, and, later on, several of such elements have been actually identified by the use of the electric current in creating vibrations in the ether. The limit is probably not reached yet, but as each new element is discovered its affinities are sought by the chemist, its sensibility to various forms of vibratory motion are investigated by the dynamist, as we may term the physicist who is seeking the laws of either heat or light or electricity, and then it is the function of the civil engineer to study how it can best be applied to the use and convenience of man. For, ever since the beginning of the nineteenth century, the evidence has been cumulative that matter in motion accounts for all physical phenomena, that motion produces energy, that energy is never wasted, but is simply transformed, and that it manifests itself to the senses of man in various modes which are appreciable by the several organs of sense.

What our senses recognize as chemical affinity, heat, light and electricity, are simply conditions of matter induced by vibrations or quivers or waves or strains, whatever we may call them, of different kinds and at different velocities. Neither matter

nor motion can be originated by man, but, by a careful study of the sequence of events, control can be acquired of their modes of interaction, and natural phenomena can be artificially reproduced and other phenomena be produced. The intelligent application and direction of such means of control is the function of the civil engineer.

With the advance of science, the scope of civil engineering widened and advanced. The study of the action of forces induced analytical investigation of the means by which forces could be resisted and the best results obtained from proper distribution and arrangement of materials of different kinds. Steamships and locomotive engines were constructed by which the products of the earth and the manufactures of man, by machines and methods not before conceived, could be transported across the seas and overland by artificial highways and across bridges of previously unimagined span; and light and heat and electricity and water could be delivered in the apartment of every person to be used at will.

It was in the carrying out of the delivery of pure and wholesome water and the removal of its unused surplus that the civil engineer first was called on to deal with organic life. That minute organisms affected the comfort and the health of man had been recognized for hundreds of years. In the middle of the seventeenth century Leeuwenhoek, a Dutch maker of microscopes, discovered and described bacteria, and Nicholas Andry, a pathologist, ascribed to them the causation of disease. But later scientists discarded the idea, and it was not until 1831 that any real advances were made in the study of these microorganisms, and it is only within the last twelve years that it has become thoroughly recognized that the regulation of the growth of living organisms in air and water and sewage is necessary and practicable, and comes within the domain of civil engineering.

Indirectly, however, biological research has been one of the most important factors in the progress of engineering science, by calling the attention of students of physics to the fact that advance and not retrogression is one of the fundamental laws of nature. For the first half of the century, the old ideas of cosmogony, based on an hypothesis unsupported by proof, were prevalent everywhere. It was assumed that the world, in all its details, had been created perfect and had since been simply deteriorating and tending to a final dissolution. 'Change and decay, in all around I see,' was the dogma of the theologian, the philosopher and the scientist alike. While it had come to be recognized that the forms of inorganic matter could be changed by man, and that by the exercise of man's intelligence, certain characteristics of organic matter and the vital forces with which it was imbued could be modified and perpetuated, it was not considered possible that the superior intelligence which controlled everything could modify or transform such characteristics in any special form of matter.

But in 1859, Charles Darwin, after twenty years of study of the sequence of events in biological phenomena, demonstrated that there was an intelligence beyond that of man, which was constantly acting to change and modify the forms, the habits and the mode of life of animals and plants, and that such action resulted in the perpetuation of the fittest type of organism. The proof was irrefragable, and the effect of his wonderfully clear exposition of the processes by which his conclusions had been reached was marvelous in inducing a coordination of thought and a cooperation in methods of procedure in intelligent research in the investigation of all natural phenomena, whether relating to organic or inorganic matter.

In considering the means of directing the great sources of power, the psychological

element must not be forgotten. A mere intellectual application of the laws discovered by physical research is not enough to make a civil engineer. Breadth of view, the faculty of analyzing what has been done so as to discover how and why some enterprises have been successful and others have not, and the ability to forecast the future, are essential. These qualities are largely natural, but may be cultivated to a great extent by study and experience. That there has been a wonderful advance in this direction during the nineteenth century is shown by the great number of civil engineers who hold positions of prominence in the management and control of large enterprises which require the exercise of faculties which cannot be acquired in any other way than by experience in the designing, construction and management of engineering works.

A prominent factor in causing this advance in engineering science which has occurred simultaneously on the Continent of Europe, in Great Britain and in America, has been the collaboration of scientists. Early in the century it became evident that the multiplication of lines of research demanded a differentiation of the labor of their prosecution and a close cooperation of the workers in any special line, and various associations of specialists were formed to promote various branches of scientific research. By the middle of the century it had become apparent that civil engineering was not the prosecution of a specialty, but was the coordination and direction of the work of all specialties in science and its applications. And so in 1852, James Laurie and his associates, following the example of their English brethren, founded the American Society of Civil Engineers, the first and only national organization devoted to 'the professional improvement of its members, the encouragement of social intercourse among men of practical science, the advancement of engineering in its several branches and the establishment of a central point of reference and union for its members.' To the privileges of its membership may be admitted not only every 'professional engineer,' but also 'any person who, by scientific acquirements or practical experience, has attained a position in his special pursuit qualifying him to cooperate with engineers in the advancement of professional knowledge and practice.' This meeting of that Society, which now has 2,500 names upon its rolls of membership, and owns a commodious society house with a reference library of some 40,000 titles, is sufficient proof of the wisdom of its founders.

Recognizing, then, that progress is a law of nature, the acceleration of progress is the aim of civil engineering. It strives to stimulate the results of the slow processes of nature, by causing the sources of power to act rapidly in any desired direction. Appreciating, too, the fact that there is constant progress, and that what now seems admirably adapted to our needs may in a short time require to be superseded by improved structures and processes, the tendency of the time is toward the production of works which will have a definite term of life, rather than toward the construction of everlasting monuments. We see that in the old nations, where the effort to build for eternity was made, time has outstripped the intent of the builders and what is antiquated is useless, and we see the same thing in our own streets to-day. The idea of building a monumental structure which will hand one's name down to future ages is a fascinating one, but it is simply a survival of the engineering of the Pharaohs.

The most thorough exemplar of the condition of civil engineering at the beginning of the twentieth century is the modern office-building in a great city. One hundred

years ago, the man of enterprise who resided fifty miles from a large city and wished to consult an engineer regarding a project for a new canal, arose before daylight, struck a spark from his flint and steel, which, falling on a scrap of tinder, was blown by him into flame and from that a tallow dip was lighted. In the same primitive manner the wood fire was kindled on the kitchen hearth and his breakfast was cooked in a pot and kettle suspended from the iron crane in the fireplace. Entering the cumbrous stage coach, hung on leather springs, which passed his door, he was driven over muddy roads, crossing the narrow streams on wooden trestle bridges and the navigable rivers on a ferry boat, the paddle wheels of which were turned by a mule on a treadmill. At last he was landed in the city, where he walked through dirty streets paved with cobble-stones until he reached his destination, a plain three-story brick building founded on sand, with a damp cellar and a cesspool in the back yard. Entering a dark hall, he climbed a wooden staircase and was ushered into a neat room, rag-carpeted, warmed by a wood fire on the open hearth and lighted by a sperm-oil lamp with one wick, for it was dark by this time. No wonder that before proceeding to business he was glad to take a good stiff noggin of New England rum.

To-day, his grandson, living at the old homestead, while comfortably eating his breakfast which has been cooked over a gas range, reads in his morning paper that the high dam of the irrigation reservoir in Arizona, in which he is interested, sprang a leak the day before, and he telegraphs to his engineer in the city that he will meet him at his office at noon. Then, striking a match, he lights the lamp of his automobile which is fed by petroleum brought 200 miles underground in pipes from the wells, rolls over macadamized roads to the railroad station, where he boards a luxuriously appointed train, by which he is carried above all highways, through tunnels, under rivers, or across them on long-span steel bridges, and in an hour is deposited in the heart of the city, where he has his choice of proceeding to his destination through clean and asphalt-paved streets in electric surface cars at 9 miles an hour, elevated steam cars at 12 miles an hour, or through well-lighted and ventilated tunnels at 15 miles an hour. Reaching the spot his grandfather had visited, he finds there a huge and highly decorated building, twenty or more stories high. Founded on the primeval rock, far below the surface of the natural ground, the superjacent strata of compressible material having been penetrated by caissons of sheet metal sunk by the use of air compressed by powerful pumps driven by steam or electricity generated at a power station half a mile or more away, and these caissons filled with a manufactured rock such as the ordinary processes of nature would require millions of years to produce, there is erected a cage of steel, the composition of which has been specified, and the form and mode of construction of which have been so computed that the force of the elements cannot overthrow the structure or even cause it to sway perceptibly. Towering above the courts of Law, the temples of Religion and the palaces of the Arts, the meshes of this mighty cage are filled with products of the earth, the mine and the forest, transformed so as to be strong and light and incombustible, and all interwoven with pipes and wires, each in its proper place and noted on the plans. In one set of these pipes there is pure water, which has been collected from a mountain area of igneous geological formation, depopulated and free from swamps, on which a record of the daily rainfall is kept, and in which impounding reservoirs have been constructed by masonry dams across its valleys. From these reservoirs the water,

after filtration through clean sand, is conveyed 30 or 40 miles through steel or masonry conduits to covered reservoirs, whence it is drawn as needed through cast-iron pipes to the building where it is to be used, and there distributed to all parts of it, chilled nearly to the freezing point through one system of pipes or heated nearly to the boiling point, through another system. Another set of pipes carries steam, which, passing through radiators, keeps the temperature of the air throughout the building at the proper standard for comfort. Sanitary conveniences are provided everywhere, and all wastes are consumed within the building by the surplus heat generated, leaving only ashes to be removed. Wires convey electric currents to all points, so that the occupant of a room, sitting at his desk, can by the touch of a button ventilate his apartment, illuminate it, call a messenger, be kept informed of every fluctuation in the markets, converse with anybody who is not 'busy' within 40 miles of where he sits, and if entirely 'up to date' can require his autograph and portrait to be reproduced before his eyes for identification. He dictates his correspondence and his memoranda, and 'takes his pen in hand' only to sign his name. He need not leave his seat except to consult the photograph hanging on his wall, which shows to him the latest condition of the mine, the railroad, the arid lands irrigated, the swamps reclaimed, the bridge in progress, the steamship, the water-works, the tunnel or the railroad, the dam, the filter or the sewage works, the town, the machine, the power plant or the manufacturing establishment in which he is most interested.

Entering the brilliantly lighted hallway of this building, the air of which is kept in circulation by the plunging up and down of half a dozen elevators, the visitor is lifted at a speed of 500 feet a minute, past floor after floor, crowded with the offices of financiers, managers and promoters of traffic and of trade, lawyers, chemists, contractors, manufacturers, to the headquarters of the controlling genius of the whole organism, the civil engineer. For he it is to whom all the members of this microcosm must apply for aid and advice in the successful operation of their respective occupations. It is not his to mechanically transform elements into matter, or matter into other forms, or to show how energy may be produced, but to direct the application of energy to the various forms of matter, original or produced, in such way as to bring about the most satisfactory results in the most speedy and economical manner.

He has grown with the growth of the nineteenth century, and is, so far as the relations between man and matter are concerned, its most striking product. And so, while the definition given in the 'American Edition of the Encyclopedia,' which appeared at the beginning of the century, that "civil engineers are a denomination which comprises an order or profession of persons highly respectable for their talents and scientific attainments and eminently useful under this appellation," is still true, it is hardly probable that the compiler of the Twentieth Century Encyclopedia will be content to let it stand without further explanation.

But the end is not yet; there are still many problems of nature unsolved. The experience of every day shows that there are sources of power not yet fully developed, and we cannot but say with the great poet:

"I doubt not through the ages one increasing purpose runs,
And the thoughts of men are widened with the process of the suns."

J. James R. Croes.

THE BRITISH NATIONAL ANTARCTIC EXPEDITION.

Dr. George Murray, F.R.S., keeper of the Department of Botany in the British

Museum, has been appointed director of the civilian staff of the British expedition, to fill the vacancy caused by the resignation of Professor J. W. Gregory. Dr. Murray will not, however, take part in the expedition, except in so far as he will proceed with the ship to Melbourne. He will edit the scientific results. A geologist is to be appointed to do the work in this direction that would have been carried on by Professor Gregory. The other members of the scientific staff are Dr. R. Koettlitz, Mr. Hodgson, Mr. E. A. Wilson, Mr. William Shackleton and Mr. R. Skelton. Full instructions to the commander and to the scientific director of the civilian scientific staff have been drawn up and are signed by Sir William Huggins, president of the Royal Society, and Sir Clements Markham, president of the Royal Geographical Society. They are as follows:

INSTRUCTIONS TO THE COMMANDER.

1. The Royal Society and the Royal Geographical Society, with the assistance of his Majesty's Government, have fitted out an expedition for scientific discovery and exploration in the Antarctic regions, and have entrusted you with the command.

2. The objects of the expedition are: (*a*) to determine, as far as possible, the nature, condition and extent of that portion of the South Polar lands which is included in the scope of your expedition; and (*b*) to make a magnetic survey in the southern regions to the south of the 40th parallel, and to carry on meteorological, oceanographic, geological, biological and physical investigations and researches. Neither of these objects is to be sacrificed to the other.

3. The scientific work of the executive officers of the ship will be under your immediate control, and will include magnetic and meteorological observations, astronomical observations, surveying and charting, and sounding operations.

4. Associated with you, but under your command, there will be a civilian scientific staff, with a director at their head. A copy of his instructions accompanies these instructions to you.

5. In all questions connected with the scientific conduct of the expedition you will, as a matter of course, consider the director as your colleague, and on all these matters you will observe such consideration in respect to his wishes and suggestions as may be consistent with a due regard to the instructions under which you are acting, to the safe navigation of the ship, and to the comfort, health, discipline and efficiency of all under your command. Those friendly relations and unreserved communications should be maintained between you which will tend so materially to the success of an expedition from which so many important results are looked for.

6. As the scientific objects of the expedition are manifold, some of them will come under the immediate supervision of the director and his staff; others will depend for their success on the joint cooperation of the naval and civil elements; while some will demand the undivided attention of yourself and your officers. Upon the harmonious working and hearty cooperation of all must depend the result of the expedition as a whole.

7. The expedition will be supplied with a complete set of magnetic instruments, both for observations at sea and on shore. Instructions for their use have been drawn up by Captain Creak, R.N., and yourself and three of your officers have gone through a course of instruction at Deptford with Captain Creak and at Kew Observatory. The magnetic observatory on board the *Discovery* has been carefully constructed with a view to securing it from any proximity to steel or iron, and this has involved considerable expense and some sacrifice in other respects. We, therefore, impress upon

you that the greatest importance is attached to the series of magnetic observations to be taken under your superintendence, and we desire that you will spare no pains to ensure their accuracy and continuity. The base station for your magnetic work will be at Melbourne, or at Christchurch, in New Zealand. A secondary base station is to be established by you, if possible, in Victoria Land. You should endeavor to carry the magnetic survey from the Cape to your primary base station, south of the 40th parallel, and from the same station across the Pacific to the meridian of Greenwich. It is also desired that you should observe along the tracks of Ross, in order to ascertain the magnetic changes that have taken place in the interval between the two voyages.

8. Geographical discovery and scientific exploration by sea and land should be conducted in two quadrants of the four into which the Antarctic regions are divided for convenience of reference—namely, the Victoria and Ross Quadrants. It is desired that the extent of land should be ascertained by following the coast lines, that the depth and nature of the ice cap should be investigated, as well as the nature of the volcanic region, of the mountain ranges, and especially of any fossiliferous rocks.

9. A German expedition will start at the same time as the *Discovery*, and it is hoped that there will be cordial cooperation between the two expeditions as regards magnetic and meteorological observations, and in all other matters if opportunities offer for such cooperation. It is understood that the German expedition will establish an observatory on Kerguelen Island, and will then proceed to explore the Enderby Quadrant, probably shaping a course south between the 70° E. and 80° E. meridians, with the object of wintering on the western side of Victoria Land, whence exploring sledge parties will be sent inland. The Government of the Argentine Republic has undertaken to establish a magnetic observatory on Staten Island.

10. You will see that the meteorological observations are regularly taken every two hours, and, also, in accordance with a suggestion from the Berlin committee, every day at Greenwich noon. It is very desirable that there should, if possible, be a series of meteorological observations to the south of the 74th parallel.

11. As regards magnetic work and meteorological observations generally, you will follow the program arranged between the German and British committees, with the terms of which you are acquainted.

12. Whenever it is possible, while at sea, deep-sea sounding should be taken with serial temperatures, and samples of sea water at various depths are to be obtained, for physical and chemical analysis. Dredging operations are to be carried on as frequently as possible, and all opportunities are to be taken for making biological and geological collections.

13. Instructions will be supplied for the various scientific observations; and the officers of the expedition will be furnished with a manual, prepared and edited by Dr. George Murray, on similar lines and with the same objects as the scientific manuals supplied to the Arctic expedition of 1875.

14. On leaving this country you are to proceed to Melbourne, or Lyttelton (Christchurch), New Zealand, touching at any port or ports on the way that you may consider it necessary or desirable to visit for supplies or repairs. Before leaving your base station you will fill up with live stock, coal, and other necessaries; and you will leave the port with three years' provisions on board, and fully supplied for wintering and for sledge travelling.

15. You are to proceed at once to the edge of the pack and to force your vessel through it to the open water to the south.

The pack is supposed to be closer in December than it has been found to be later in the season. But this is believed to depend rather on its position than on the time; and the great difference between a steamer and a sailing vessel perhaps makes up for any difference in the condition of the pack.

16. On reaching the south water you are at liberty to devote to exploration the earlier portion of the navigable season; but such exploration should, if possible, include an examination of the coast from Cape Johnson to Cape Crozier, with a view to finding a safe and suitable place for the operations of landing in the event of your deciding that the ship shall not winter in the ice.

The chief points of geographical interest are as follows:—To explore the Ice Barrier of Sir James Ross to its eastern extremity; to discover the land which was believed by Ross to flank the barrier to the eastward, or to ascertain that it does not exist; and generally to endeavor to solve the very important physical and geographical questions connected with this remarkable ice formation.

17. Owing to our very imperfect knowledge of the conditions which prevail in the Antarctic seas, we cannot pronounce definitely whether it will be necessary for the ship to make her way out of the ice before the winter sets in, or whether she should winter in the Antarctic regions. It is for you to decide on this important question after a careful examination of the local conditions.

18. If you should decide that the ship shall winter in the ice, the following instructions are to be observed:

a. Your efforts, as regards geographical exploration, should be directed, with the help of depots, to three objects—namely, an advance into the western mountains, an advance to the south, and the exploration of the volcanic region.

b. The director and his staff shall be allowed all facilities for the prosecution of their researches.

c. In carrying out *a* and *b* due regard is to be had to the safety and requirements of the expedition as a whole.

d. You have been provided by Sir Leopold McClintock and by Dr. Nansen with complete details respecting sledge work both by men and dogs, and you have yourself superintended every item of the preparations connected with food, clothing and equipment. You will be guided by the information and knowledge thus acquired.

e. Lieut. Armitage, R.N.R., who has been appointed second in command and navigator to the expedition, has had experience in the work of taking astronomical, magnetic and meteorological observations during three Polar winters. He has also acquired experience in sledge traveling and in the driving and management of dogs. You will, no doubt, find his knowledge and experience of great use.

f. Early in 1903 your ship should be free from the ice of the winter quarters, and you will devote to further exploration by sea so much of the navigable season as will certainly leave time for the ship to return to the north of the pack ice. Having recruited at your base station, you will then proceed with your magnetic survey across the Pacific and return to this country.

19. If, on the other hand, you should decide not to winter, you will bear in mind that it is most important to maintain scientific observations on land throughout the winter, and therefore if you are able, in consultation with the director, to find a suitable place for a landing party between Cape Johnson and Cape Crozier, and decide that such a party can be landed and left without undue risk, the following instructions will apply:

a. You will land a party under the command of such person as you may ap-

point. Such party shall include the director, the physicist, and one of the surgeons, and such other persons as you may consider desirable. But no person is to be left without his consent in writing, which you will be careful to obtain and preserve.

b. You will give every practicable assistance in establishing on land this party, which you will supply with all available requisites, including a dwelling hut, an observer's hut, three years' provisions, stores, fuel, sledges and dogs.

c. No landing party is to be established on any other part of the coast than that between Cape Johnson and Cape Crozier, as it is above all things essential that in case of accident the approximate position of the party should be known.

d. Before it is so late as to endanger the freedom of your ship, you will proceed north of the pack and carry out magnetic observations with sounding and dredging over as many degrees of longitude (and as far south), as possible, so long as the season and your coal permit, and then return to your base station, whence you will telegraph your arrival and await further instructions.

20. You are to do your best to let us have, and to leave where you can, statements of your intentions with regard to the places where you will deposit records, and the course you will adopt, as well as particulars of your arrangements for the possible need of retreat, so that in case of accident to the ship, or detention, we shall be able to use our best endeavors to carry out your wishes in this respect.

21. In an enterprise of this nature much must be left to the discretion and judgment of the commanding officer, and we fully confide in your combined energy and prudence for the successful issue of a voyage which will command the attention of all persons interested in navigation and science throughout the civilized world. At the same time, we desire you constantly to bear in mind our anxiety for the health, comfort and safety of all entrusted to your care.

22. While employed on this service you are to take every opportunity of acquainting us with your progress and your requirements.

23. In the unfortunate event of any fatal accident happening to yourself or of your inability, from sickness or any other cause, to carry out these instructions, the command of the ship and of the expedition will devolve on Lieutenant Armitage, who is hereby directed to assume command and to execute such part of these instructions as have not been already carried out at the time of his assuming command. In the event of a similar accident to Lieutenant Armitage the command is to devolve on the executive officer next in seniority on the articles, and so on in succession.

24. All collections and all logs (except the official log), journals, charts, drawings, photographs, observations and scientific data will be the joint property of the two societies, to be disposed of as may be decided by them. Before the final return of the expedition you are to demand from the naval staff all such data, which are to be sealed up and delivered to the two presidents, or dealt with as they may direct. The director of the civilian scientific staff will be similarly responsible for the journals, collections, etc., of the officers under his control. You and the other members of the expedition will not be at liberty without our consent to make any communication to the press on matters relating to the affairs of the expedition, nor to publish independent narratives until six months after the issue of the official narrative. All communications are to be made to us, addressed to the care of the Secretary of the National Antarctic Expedition, London.

25. The *Discovery* is not one of his Maj-

esty's ships, but is registered under the Merchant Shipping Act, 1894, and is governed by it. Copies of this act will be supplied to you. You will see that the officers and crew sign the ship's articles as required by the act. The scientific staff will not sign articles, but are to be treated as cabin passengers. You must be careful not to take more than 12 persons as passengers.

26. The vessel has been covered by insurance, and, in the event of her sustaining any damage during the voyage, to recover the claim from the underwriters it will be necessary for you to call in the services of Lloyd's agent, or, in his absence, an independent surveyor, at the first port of call, in order that the damage may be surveyed before repairs are effected. His survey report, together with the accounts for repairs and supporting vouchers should be sent to us by first mail, together with a certified extract from the official log reporting the casualty.

In the event of damage occurring after you have left civilized regions precise particulars should be entered in the log, and the damage should be surveyed and repaired as soon as you return to a port where Lloyd's agent or other surveyor is available.

27. The *Discovery* is the first ship that has ever been built expressly for scientific purposes in these kingdoms. It is an honor to receive the command of her; but we are impressed with the difficulty of the enterprise which has been entrused to you and with the serious character of your responsibilities. The expedition is an undertaking of national importance, and science cannot fail to benefit from the efforts of those engaged in it. You may rely upon our support on all occasions, and we feel assured that all on board the *Discovery* will do their utmost to further the objects of the expedition.

INSTRUCTIONS TO THE SCIENTIFIC DIRECTOR OF THE CIVILIAN SCIENTIFIC STAFF.

1. The Royal Society and the Royal Geographical Society have approved your appointment as Director of the Civilian Scientific Staff of their Antarctic Expedition.

2. A copy of the instructions to the commander of the expedition accompanies these instructions, which are supplemental to them. You will see from the instructions to the commander what the objects of the expedition are, and your position relatively to them.

3. You will direct the scientific work of the gentlemen who have been appointed to assist you.

4. The names of the gentlemen associated with you are as follows:—(1) Mr. Hodgson (biologist); (2) Mr. Shackleton (physicist). The services of the two medical officers will be at your disposal for scientific work when not engaged on the work of their own department—namely, Dr. Koettlitz (botanist), and Dr. Wilson (zoologist).

5. You will note that the commander of the expedition has been instructed to communicate freely with you on all matters connected with the scientific objects of the expedition, and, as far as possible, to meet your views and wishes in connection with them. The societies feel assured that you will cooperate and act in concert with him, with a view, as far as possible, to secure the success of an enterprise which it is hoped will be attended with important results in the various branches of science which it is intended to investigate.

6. All collections, logs, journals, charts, drawings, photographs, observations and scientific data will be the joint property of the two societies, to be disposed of as may be decided by them. Before the final return of the expedition, you are to demand from the staff under your control all such data, which are to be sealed up and delivered to the two presidents, or dealt with as they

may direct. On the return of the expedition you will be expected to superintend the distribution of specimens to specialists approved of by the two councils or their representatives, and to edit the resulting reports. You will also be expected to contribute a report on the scientific results of the expedition for the official narrative. As it may be desirable during the progress of the voyage that some new scientific discovery should be at once made known in the interests of science, you will, in such a case, inform us of it by the earliest opportunity.

7. You and the other members of the expedition will not be at liberty, without our consent, to make any communication to the press on matters relating in any way to the affairs of the expedition, nor to publish independent narratives until six months after the issue of the official narrative. All communications are to be made to us, addressed to the care of the secretary of the National Antarctic Expedition, London.

8. Should any vacancies in the scientific staff occur after the expedition has sailed from England, you may, with the concurrence of the commander, make such arrangements as you think desirable to fill the same, should no one have been appointed from England.

9. You and the members of the scientific staff will be cabin passengers joining the expedition at your own risk, and neither the owners nor the captain are to be responsible for any accident or misfortune which may happen to you. You will obtain from each member a letter to this effect.

The instructions are signed by the Presidents of the Royal Society and the Royal Geographical Society.

*TEACHING OF CHEMISTRY IN SCHOOLS—1876, 1901.**

Before comparing, or contrasting, the teaching of chemistry twenty-five years ago with that of to-day, it seems desirable to trace briefly the evolution of chemistry from a much earlier period. This will enable us to see at what part of the evolutionary line high-school chemistry had arrived when the American Chemical Society was founded, and where it now is.

In the alchemistic age the effort was to conceal, not reveal, facts. All the language is most obscure, and writers are pervaded with the idea that the wrath of God will rest upon them if they reveal the secrets of their laboratories. Basil Valentine says he fears he has spoken so plainly that he shall be doomed at the last great day; but the modern French writer Figuier facetiously remarks that all the adepts who have ever tried to decipher his language regard it as certain that he was one of the elect. There was no teaching, as there was no science. A little later, when an alchemist disclosed the philosopher's stone or the elixir it was to a few persons for large money considerations. If he made pretended transformations into gold in presence of spectators, the *methods* were kept secret.

With the advent of scientific chemistry, even among the phlogistics, secrecy became a lost art. Experiments began to be written about and talked of, but were not at first made in public. Books contained no illustrations. The question and answer method got into chemistry as in all other teaching. Jane Marcet's little book 'Conversations on Chemistry,' first published in London in 1806—which ran through 20 editions and was revised as late as 1855—set two generations to thinking of the marvelous revelations of nature. It consisted wholly of questions and answers, only the later editions being illustrated.

With the Lavoisierian chemistry—in fact, antedating it somewhat—came the demonstrative lecture method of teaching. As the professor—for this was a feature of colleges and medical schools only—performed his

* Read at the 25th anniversary of the American Chemical Society.

experiments before the class, and called attention to the phenomena, which he explained either by phlogiston or according to the doctrine of Lavoisier, his hearers gained much. If there was still something of the alchemistic glamour, the subject could be studied afterwards in a suitable text-book. All in all, it was the most noteworthy advance in teaching that had taken place up to that time. As the question and answer method will never disappear from educational systems, so the best in the lecture method came to stay, and will always have its place. But it was far from being ideal, or final. During that period the man who could deliver the most faultless lecture was the best teacher.

But another step was to be taken, in which, in place of a passive observer, the student must prepare and set up his own apparatus, mix his chemicals, adapt the conditions, watch the phenomena and arrive at conclusions. This was a more radical revolution than even the lecture method, and it merits more than passing notice. Liebig is accredited as the inventor of the laboratory method as applied to chemistry. This method, transplanted in America by one of his pupils, Eben Horsford, who in 1848 was appointed professor of chemistry at the Lawrence Scientific School, Cambridge, Mass., gained a slow and struggling popularity. It was at the same institution and about the same time that Louis Agassiz began to employ the laboratory method in natural science. In 1850 Professor Cooke fitted up as a laboratory, mostly at his own expense, a basement room in University Hall at Harvard College, where a few selected students were admitted. There was no gas or running water. After seven years more, against great opposition, he succeeded in having laboratory work a requirement for Harvard students in chemistry. The first laboratory instruction in chemistry for *medical students* in this country was in 1853 at the Harvard Medical School. It took another quarter of a century for the laboratory idea to permeate any but the larger colleges, and chemistry continued to be taught by the recitation method. One of the earliest, perhaps the first, secondary school to adopt the new idea was the Girls' High and Normal School of Boston, about 1865. It was followed by the Cambridge, Mass., High School in 1866, and the English High of Boston, in 1871. One of the early teachers says: "A chemical laboratory for pupils was a rarity; all foreigners and visitors to the city were brought to see it, and they opened their eyes in amazement at the strange sight." This was in 1870, and plans and photographs of this workshop for students were in demand from various parts of the United States.

But, generally speaking, the laboratory method, as regards high-schools, is a development of the past twenty-five years. A new era in chemistry teaching was dawning. It was greatly stimulated by the summer schools of science which sprang up in colleges all over the land. The first teachers' school of science was that of Louis Agassiz in natural history, held on the island of Penekese during the summer of 1869. In subsequent years this school, enlarged and broadened to include chemistry and other branches of learning, was held in Cambridge, Mass., the example of Harvard being followed by other institutions, and the laboratory idea was spread broadcast.

At first the workshop was usually put in the basement of the school building, and laboratory work was an extra subject, or voluntary exercise to be done after school hours by those sufficiently interested; hence very little was required. As the work grew and its value became apparent, note-taking was introduced. 'Observation' and 'conclusion' made up the notes, mostly mechanical, without much connection. After a time, this being found insufficient,

the teacher tried to put the student in the attitude of an investigator. He must describe the apparatus—which he has himself set up—the chemicals and how he has mixed them, the operations he has performed; must trace the phenomena and try to ascertain what the experiment shows, must test his products, and, so far as he is concerned, do real, original work. Finally he must write out in fairly good English all the above operations, observations and results. Later on, when he becomes somewhat familiar with the principles of the science, problems of a practical nature are given him to solve—to make given compounds, or to separate mixtures. This leads on to qualitative analysis, a brief course in which is quite generally taken now in the high-school, always following general chemistry and often put into a second-year course.

This accuracy of detail naturally led to two further developments: (1) A logical or scientific sequence of experiments. (2) Quantitative work—which is one of the latest phases of this method. In fact, quantitative work for beginners, who have not had thorough training in general, qualitative manipulations, is still a doubtful experiment—one which the colleges, technological and medical schools, are so far answering, for the most part, in the negative. Those in favor of the scheme in elementary work reason that it inculcates greater accuracy and skill in manipulation than mere qualitative work, gives the student an idea of research methods, and makes his work complete. The opponents claim that to a beginner the underlying facts and principles of science are of paramount importance, that the *qualitative* in evolution precedes the *quantitative*, and—since time is limited—research methods are better suited to such students as pursue the subject further. A well-known teacher writes: "The attempts to beat out methods theoretically correct, the putting quantitative before qualitative and the ignoring of the great primal facts which lead easily into those parts of the subject which concern the great body of men and women, have a tendency to lessen the interest."

The introduction of the laboratory method presented a new problem. When text-book work was the only feature, every chemistry hour was a reciting period. With the advent of the lecture table came a division of time between demonstration and recitation. The laboratory feature necessitated a further division, involving the question: How much time, relatively, ought to be given to laboratory, to lecture and to recitation? In the solution of this question there has been no unanimity, rather the greatest diversity, of result, each school with its peculiar environment making its own answer. In some instances the entire time is devoted to laboratory work, and in such cases the text-book is usually discarded. A new method always runs to extremes in individual cases. As a recent writer says: "Chemistry has suffered from the irresponsible wave of laboratory madness which has swept over the whole educational world. Laboratory work has been carried far beyond its limits, and things have been expected of it which it never did and never can do." It seems safe to believe that the problem will finally resolve itself into a proper equating of the time ratio between text-book, lecture work and laboratory.

Another outgrowth of the last quarter is the conference, and reciprocal recitation—to coin an expression—in which the student becomes a questioner and the teacher recites and explains. The great value of this method—which may take up half or the whole of a recitation period—can be revealed only on trial. It shows what the teacher never knows before hand, *viz.*, the standpoint from which a pupil views a sub-

ject, and that, after all, is the case to be diagnosed. The opposite view that nothing should be told the student, but everything evolved, by a series of questions, from his brain—callow and ignorant of first principles though it be—is still advocated by a few in authority. It is the inductive method gone to seed.

Applied to chemistry teaching the inductive method, though in use earlier in some schools, was largely a growth of the decade beginning about 1885. The first text-books avowedly inductive began to appear. Like other good things, this Socratic, time-killing process was almost run into the ground by enthusiasts. Newth says: "In actual practice the *purely* inductive method of instruction breaks down. There is so much that the student is required to learn that life itself is not long enough, and certainly the limited time at the disposal of the student is all too short to admit of his going through the necessarily slow process of gaining this knowledge by his own investigation."

That part of induction which has the stamp of perpetuity consists in the teacher's quizzing the student while the latter is making an experiment. In this manner a world of thought and suggestiveness may be opened up to the imagination, and the method thus employed subserve a highly useful end.

In some schools the time allotted to chemistry is not more than it was 25 years ago, and certain laboratories blossomed into full maturity almost at the outset, but not so with the great majority. The chemical theory is taught more effectively now than then by the use of charts and blocks. Laws which cannot well be shown by experiment are illustrated by simple mechanical devices and diagrams, so that, instead of mere words, the pupil can get a clear mental picture of the given law. Many problems in practical chemistry are introduced and the bearing of equations, valence and stereochemistry is studied as it was not 25 years ago. *Non multa, sed multum* is the watchword of the best teachers in chemistry, as in other branches. How much these improvements are due to the meetings and the *Journal of the American Chemical Society*, it is impossible to state. In the dissemination of chemical knowledge this magazine has been a great power. The history of important chemical discoveries, and something of biography are also taught in high-schools to-day. Instead of one text-book, students in the best schools have access to a large number of books and are encouraged to do outside reading in scientific periodicals.

What then have we found in high-schools as the result of our inquiry?

In 1876 a prevalent view that chemistry has little educational value.

In 1901 chemistry found in practically every high school curriculum.

In 1876 school committees very loath to expend anything for laboratories or equipment.

In 1901 the laboratory and lecture room among the first considerations in constructing a high-school building.

In 1876 practically no laboratories, the text-book recitation dominant, very few demonstrative lectures.

In 1901 chemical work mostly divided into lecture, laboratory and conference periods.

In 1876 no notes of work.

In 1901 notes containing description of apparatus, manipulation, chemicals, phenomena, inferences, reactions, couched in more or less correct English.

In 1876 deductive methods almost wholly.

In 1901 methods partly inductive, partly deductive.

In 1876 the student committing facts to memory.

In 1901 the student more or less an investigator.

In 1876 a smattering of general chemistry only.

In 1901 both general chemistry and qualitative analysis, with some quantitative work, to illustrate laws.

The object and aim of chemical study in the two periods may be illustrated by excerpts from the prefaces of two books. The one in 1876 says that the author "has sought to make a pleasant study which the pupil can master in a single term, so that all its truths may become to him household words. This work is designed for the instruction of youth and for their sake clearness and simplicity have been preferred to recondite accuracy."

The 1901 author says: "The tendency of the present day is to make the student, from the very beginning, an *investigator;* to train and develop his faculties for observation; to make him find out facts and discover truths for himself; in other words, to make him *think* instead of merely committing to memory what others have thought."

What will be the next progressive movement in secondary-school chemistry? Already a few dim shadows are being cast which may materialize. In schools of the larger cities there is a growing demand for elective courses and elective studies in every department of learning. Elective *courses* are not a new idea, but should high-school pupils be allowed to choose *all their studies* throughout a three or four years' course, it would profoundly affect the scope of teaching and indirectly the methods. Another coming event is the reaching down of chemistry into the grammar grades. This has been successfully done in some few cities and towns. Should the grammar grades teach chemistry and the high-schools have elective studies, the higher grades of quantitative, volumetric, organic and theoretical chemistry may be forced into the high-school, and a minimized university result.

Another indication is that of cooperation. Chemistry teachers are beginning to form associations for discussion of methods and aims. There is at present a wide diversity in methods of chemistry instruction. While these can never be wholly unified, nor is it desirable that they should be, owing to varied environments, yet discussions of methods, aims and results are most stimulating, and secondary schools may, in this respect, take a step in advance of colleges and universities. Magazines and periodicals for the discussion of what is latest and best in science-teaching mark also the new era, and are an indication in the same direction. The *Journal of the American Chemical Society*, whose 25th anniversary we celebrate to-day, may join hands with its infant sister, *School Science*, the youngest representative of scientific education.

From the twentieth century aspect of chemistry study, is it too much to say that it realizes more fully than perhaps any other single subject the ideal for combined manual, observational and intellectual training?

Rufus P. Williams.

SCIENTIFIC BOOKS.

Public Water Supplies: Requirements, Resources, and the Construction of Works. By F. E. Turneaure and F. H. Russell, professors in the University of Wisconsin. New York, John Wiley & Sons. 1901. Octavo. Pp. xiv + 746.

This volume has been prepared with particular reference to the needs of teachers and students in engineering colleges, and it is from this point of view that the following remarks are made: The field covered is a large one and in no other branch of engineering has there been a greater growth during the past twenty-five years. In particular the methods of purification of water have, by the aid of the sciences of chemistry and bacteriology, become so thoroughly understood that they are now of equal importance with the operations for storage and distribution.

Part I. of the volume, covering 197 pages, relates to the sources of supply, rainfall, flow of

streams, chemical and bacterial examinations, and the diseases caused by impure water. Part II., consisting of 549 pages, treats of hydraulics, works for the collection and storage of water, purification systems, and the methods of distribution by tanks, pipes and pumps. The space devoted to the different topics appears well proportioned to their relative importance, the subjects themselves are usually thoroughly treated and descriptions of the most modern practice are freely given.

The question of economy in engineering construction is a controlling one in all comparative designs, and this book is one of the few to bring it prominently to the notice of the student. The annual interest on the first cost, plus the annual cost of operation and maintenance, is to be made a minimum, and the general method of doing this is set forth clearly and satisfactorily. Even in cases where the general method is not of direct application, the economic arrangement of details is often discussed. Thus, the economic size of one sand filter bed is shown to depend upon the number of beds, and upon the cost of walls and bottom filling as compared with the cost of piping, valves and other appurtenances. Such discussions are a characteristic of modern engineering and their introduction into text-books should be welcomed, for economic construction is the corner stone of sound engineering practice.

The general subject of hydraulics is set forth only to a limited extent, as a full treatment could scarcely be given in a single chapter. The laws of flow of ground water are, however, fully presented and useful formulas developed, while the subject of water hammer is discussed in a novel manner. Reservoirs, dams, filtration systems, conduits and pipes, pumping machinery, and the distribution of water, are well and thoroughly treated, with numerous examples of constructed works. In short, it may safely be said that the book constitutes one of the very best treatises on water-supply engineering now before the American public.

At the end of each chapter, with the exception of the brief one on hydraulics, there is given a useful list of literature. Periodicals are cited in italics, while transactions and books are in Roman type. Few engineering students will know what is meant by *Hyg. Rund.*, *Cent. f. Bakt.*, and other similar abbreviations which should properly have been written out in full. The book seems, however, remarkably free from errors that are apt to occur in a first edition. The most serious ones noted are on page 213, where it is said that one U. S. gallon is 0.1605 cubic feet, and on page 216 where the word 'longitudinally' should have been 'transversely.' The book is well printed with the exception of the cuts, many of which properly deserve severe criticism.

The chapter on chemical and bacterial examinations of water appears to be the only one that is likely to prove unsatisfactory to engineering students. Bacteria are not defined and described in respect to size, form, color and functions, and the impression is given that all are specific germs of disease, while there is no hint as to the useful work performed by many species in transforming injurious decaying matter into harmless constituents. At the foot of page 123 a statement is made implying that bacteria in water are found in the suspended matter and not in solution. On page 125 it is said that a water rich in bacteria is not necessarily poor in quality. On the whole this discussion lacks that definiteness and logical method which is demanded by engineers. The chemical part of the chapter is better, but it is also lacking in definiteness, as no records of analyses are given and little is said which will enable a student or engineer to interpret the results of a water analysis.

The field of water supply on both the sanitary and construction side has become so vast that special treatises on the chemistry and bacteriology of water, filtration, reservoirs, standpipes and distribution plants are demanded by practicing engineers. For the student, however, such differentiation is neither feasible nor desirable, and this volume, with the exception above noted, presents such a satisfactory review of the theory and practice of the entire subject that it will undoubtedly prove of great service in technical education, and at the same time take high rank as a manual for young engineers.

MANSFIELD MERRIMAN.

LEHIGH UNIVERSITY.

Zoological Results based on Material from New Britain, New Guinea, Loyalty Islands and elsewhere, collected during the years 1865, 1896 and 1897, by Arthur Willey. Cambridge, Eng., the University Press. 4to. Part V. December, 1900. Pp. 531–690; pls. LIV.–LXXIV.

The fifth installment of Dr. Willey's 'Zoological Results' contains six papers, one of which deals with cœlenterates, two with worms, two with crustaceans, and one with vertebrates. The first of these is by E. M. Pratt who describes the soft parts of the rare coral *Neohelia porcellana*. This species, which was previously known only from material obtained by the *Challenger*, belongs to the Oculinidæ, and as all its nearest relatives are fossils the importance of supplementing the earlier description of Moseley by a full account of its anatomy as given in the present paper is obvious.

The parasitic worms gathered by Dr. Willey were studied by A. E. Shipley who found that the collection contained seventeen species, nine of which were new. Two were trematodes and of these sufficient material was obtained of *Monostomum trigonocephalum* to enable Shipley to give a very full description of the anatomy of this form. Of the seven species of tapeworms six were new; two of minute size were taken from the intestine of a ray, one each from the digestive tract of a lizard, a snake, a fruit-eating pigeon and an albatross. Of the six species of round worms only one was new. Two specimens, however, were particularly interesting because of new light thrown on their geographical distribution. *Physaloptera obtusissima* had previously been recorded only from South American snakes, but apparently it also infests the native snakes of New Britain, and *P. retusa*, previously found only in Brazilian lizards, is now for the first time recorded from New Britain. A new species of *Gordius* and a new representative of the family Linguatulidæ are described.

The nemertines are reported upon by R. C. Punnett. Six of the twelve species collected were new. Five belong to the genus *Eupolia* whose headquarters seems to be the Malay archipelago. A new species, *Carinesta orientalis*, on the other hand, is the first Protonemertine to be recorded from regions outside the Atlantic and Mediterranean.

The extensive collection of lower crustaceans contains, according to T. R. R. Stebbing, forty-six species, of which twenty-three are new. Eight of these represent new genera. Of special interest is *Panaietis incamerata*, a semi-parasitic copepod occurring in the pallial chamber of gastropods, and *Anchicaligus nautili*, a parasitic copepod infesting the mantle chamber of *Nautilus pompilius* and certain slimy portions of the shell of *N. macromphalus*.

The young of the robber crab, *Birgus latro*, have been made the subject of a short but interesting report by L. A. Borradaile. The adult robber crabs are land animals living some distance from the coast and, according to report, have been supposed to bring forth young resembling the parent. Thus it has been surmised that their development was without the larval metamorphosis usually characteristic of other crustaceans. Direct evidence of this has been wanting, for accurate observers have not heretofore happened on the crabs in the breeding season. Dr. Willey, however, reports the capture close to the sea of females with large masses of brown eggs attached to their abdominal appendages. An examination of this material showed that the young hatched as in allied species, in the zoæa stage. When hatching begins the females presumably shake the young off in the water. The further development of *Birgus* is without doubt accompanied by a metamorphosis as in other hermit crabs.

G. A. Boulenger describes a new blind snake, *Typhlops willeyi*, from the island of Lifu. This is of interest since it is only the second species of land snake recorded from this island.

G. H. Parker.

Ergebnisse der neueren Sporozoenforschung. M. Lühe. Jena, Gustav Fischer. Price, 2 M. 80.

Lühe's summary of the results of more recent investigations on Sporozoa is practically a revised reprint of his articles which recently appeared in the *Centralblatt für Bakteriologie, Parasitenkunde und Infektionskrankheiten*, Volumes XXVII. and XXVIII., and represents a summary of the zoological data contained in nu-

merous zoological and medical articles published in different languages and in different parts of the world.

First he gives a discussion of the general life cycle of the coccidia. This is followed by a classification of the coccidia. Chapter II. discusses the life cycle of the malaria plasmodium, while Chapter III. is given up to a general discussion of the more recent results in the other groups of Sporozoa. Taken as a whole, the material is well digested, and makes an excellent summary for any one who wishes to inform himself quickly regarding the most recent results in investigations concerning Sporozoa.

The work contains 35 illustrations, which add to a proper understanding of the text. One of the great difficulties in following the articles of the present day on the Sporozoa is the fact that so many different authors have considered it necessary or advisable to introduce so many new terms designating the different stages of development. If, for instance, we compare Ross's articles of 1898 with those of 1899 or 1900, we find different terms used for the same stage. Ray Lankester in 1900 uses still other terms; Harvey Gibson an entirely different terminology; while Grassi has repeatedly changed his technical terms. One almost needs a separate dictionary to-day to understand the literature on the Sporozoa. Lühe has in the main followed the terminology adopted by Schaudinn, 1899, and he gives a table by which it is possible to follow the terminology adopted by most of the other authors.

So far as the coccidia are concerned, Lühe's discussion compares quite favorably with the recent summary given by Rafael Blanchard in the *Société zoologique de France*, but it certainly is not superior to Blanchard's work in either style or presentation; in fact, it would be very difficult to improve on Blanchard's article. Lühe's discussion of the malaria parasite compares very favorably with the discussion recently published by Blanchard, Laveran and others in the French Academy of Medicine, but in addition to the abstract discussion of the life cycle of the parasite, he gives a general historical introduction to the subject, with a review of recent literature, and makes an effort to establish the priority of certain discoveries. We are somewhat surprised to miss in this introduction all reference to the valuable contribution by Dr. King, of Washington, who was apparently the first author to give a scientific summary of the reasons in favor of the view of the transmission of malaria by mosquitoes.

Chapter III. assumes on the part of the reader a certain amount of knowledge of the groups discussed.

One point in connection with the work we can hardly leave unmentioned, and that is the antiquated method of citing literature. Each group has its own bibliography arranged alphabetically by authors. This results not only in unnecessary repetition, but also in confusion; for instance, Max Braun's treatise on animal parasites of man is No. 2 in the first bibliography, No. 12 in the second bibliography, and No. 2 in the third. The work would be greatly improved if the Harvard system of bibliography had been adopted.

C. W. STILES.

SCIENTIFIC JOURNALS AND ARTICLES.

THE May number of the *Bulletin of the American Mathematical Society* contains the following articles: 'Non-Oscillatory Linear Differential Equations of the Second Order,' by M. Bôcher; 'Concerning Real and Complex Continuous Groups,' by L. E. Dickson; 'On Holomorphisms and Primitive Roots,' by G. A. Miller; Reviews of Graf and Gubler's Bessel Functions II., by V. Snyder, and of Ricci's Theory of Surfaces, by H. S. White; 'Notes'; 'New Publications.' The June number contains reports of the April meeting of the Society, by E. Kasner, and of the April meeting of the Chicago Section, by T. F. Holgate; 'The Value of a Certain Integral,' by F. Morley; 'On the Algebraic Potential Curves,' by E. Kasner; Review of Steinmetz's Alternating Current Phenomena,' by J. B. Whitehead, Jr.; and of de Tannenberg's Applications of the Calculus to Geometry, by L. P. Eisenhart; 'Notes'; 'New Publications.' The July number, concluding Volume 7 of the *Bulletin*, contains: 'Surfaces whose First and Second Fundamental Forms are the Second and First Respectively

of Another Surface,' by L. P. Eisenhart; 'On Groups Generated by Two Operators,' by G. A. Miller; 'A Curious Approximate Construction for π,' by G. Peirce; Review of Manning's Non-Euclidean Geometry, by J. L. Coolidge, and of Bianchi's Differential Geometry, by J. K. Whittemore; 'Notes'; 'New Publications'; 'Tenth Annual List of Papers Read before the Society and Subsequently published'; and a sixteen-page Index of the Volume.

The Popular Science Monthly for July opens with an important article on 'The Transmission of Yellow Fever by Mosquitoes,' by George M. Sternberg, detailing the long and careful series of experiments which seem to clearly point out the mosquito as the active agent in the spreading of this disease. Incidentally it may be noted that no less than eighteen men voluntarily exposed themselves to the disease in order to test the theory of its diffusion. Under 'Climate and Carbonic Acid,' Bailey Willis discusses the evidence in favor of the theory that the glacial epochs have been caused by the absorption of carbonic dioxide from the atmosphere, permitting the radiation of heat and lowering the temperature of the earth's atmosphere. A translation is presented of the article on 'The Peopling of the Philippines,' by Rud. Virchow, and Havelock Ellis continues his 'Study of British Genius,' this instalment being devoted to pathology, from which it appears that there is a special connection between genius and gout. Edward L. Thorndike treats of 'The Intelligence of Monkeys,' deciding that they carry the animal method of learning beyond a point reached by any other of the lower animals. 'Cocaine Analgesia of the Spinal Cord' is discussed by Smith Ely Jelliffe, and Henry A. Pilsbry considers 'The Evidence of Snails on Changes of Land and Sea,' while Frank Waldo describes the work of 'The Blue Hill Meteorological Observatory,' which he considers the most successfully conducted meteorological observatory in America. The final article is on the organization and aims of 'The American Association for the Advancement of Science' apropos of its coming meeting in Denver. There is much interesting reading to be found in 'The Progress of Science.'

In *The American Naturalist* for June, W. M. Wheeler presents the first part of a paper on 'The Compound and Mixed Nests of American Ants.' Glover M. Allen describes 'The Louisiana Deer' as a subspecies under the name of *Odocœlus virginianus louisianæ*. It is a rather curious fact that the antlers of the type of the subspecies and of the two forms shown for comparison are all abnormal. R. W. Shufeldt gives an excellent paper 'On the Osteology and Systematic Position of the Screamers' (Palamedea: Chauna), in which their points of agreement and disagreement with the ducks and fowls are well shown. 'Normal Respiration and Intramolecular Respiration' are discussed by George J. Peirce, and Abram V. Mauck contributes an article 'On the Swarming and Variation in a Myriapod' (*Fontaria virginiensis*). The fifteenth instalment of the fine series of 'Synopses of North American Invertebrates' is by Hubert L. Clark and is devoted to the Holothurioidea. 'Editorial Comment' and the customary reviews complete the number.

The Auk for July is mostly devoted to systematic papers: 'Bendire's Thrasher,' by Herbert Brown; 'Birds of the Black Hills,' by Merritt Cary; 'Unpublished Letters of William MacGillivary to John James Audubon,' by Ruthven Deane; 'The Resident Land Birds of Bermuda,' by Outram Bangs and Thomas S. Bradlee, containing descriptions of several new species; 'A New Ground Dove from Western Mexico,' by Outram Bangs; 'The Monterey Hermit Thrush,' by Joseph Grinnell; 'The Winter Birds of Pea Island, North Carolina,' by Louis B. Bishop, a list of 42 species, and 'A New Sharp-tailed Finch from North Carolina,' by Louis B. Bishop. The 'General Notes' and 'Reviews of Recent Literature' are very full.

SOCIETIES AND ACADEMIES.

PHYSICS AT THE AMERICAN ASSOCIATION.

The officers of section B, Physics, Professor De Witt B. Brace, chairman, and Professor John Zeleny, secretary, have received the following titles of papers for presentation at the

joint meetings of Section B of the A. A. A. S. and the American Physical Society, to be held in Denver:

'Note on the Transmission of Radiation by Thin Films of Asphalt': Professor E. L. Nichols, Cornell University.

'The Visible and Infra-red Absorption Spectrum of Iodine in Solution': Professor E. L. Nichols and W. W. Coblentz, Ithaca, N. Y.

'Results of the Recent Magnetic Work of the U. S. Coast and Geodetic Survey': Dr. L. A. Bauer, Washington, D. C.

'The Physical Decomposition of the Earth's Permanent Magnetic Field': Dr. L. A. Bauer, Washington, D. C.

'Discharge of Electrification by Glowing Platinum and Velocity of the Ions': Professor E. Rutherford, McGill University, Montreal.

'The Absorption Spectrum of Colloid Ferric Hydrate Solutions': Professor B. E. Moore, University of Nebraska.

'Index of Refractions and Dispersion of Dilute Aqueous Solutions': Professor B. E. Moore, University of Nebraska.

'On the Calorimetric Properties of the Ferro-Magnetic Substances with Special Reference to Nickel-Steel': B. V. Hill, University of Berlin.

'Note on Strains in very Dilute Solutions of Gelatine': B. V. Hill, University of Berlin.

'On Electro-Striction': Professor Z. S. Shearer, Cornell University.

'The Distribution of Energy in the Spectrum of the Acetylene Flame': George W. Stewart, Ithaca, N. Y.

'The Visible Spectrum of the Incandescent Lamp at Various Temperatures': Ernest Blaker, Ithaca, N. Y.

'The Heat of Combustion of Acetylene': H. A. Rands, Ithaca, N. Y.

'The Radiant Efficiency of Vacuum Tubes': Edward E. Roberts, Ithaca, N. Y.

'The Fall of Temperature through a Wedge-shaped Wall of Glass': Albert Ball, Ithaca, N. Y.

'Notes on the Supposed Elongation of a Dielectric in an Electrostatic Field': Professor L. T. Moore, University of Cincinnati.

'On the Cavendish Experiment and the Law of Inverse Squares in Electrostatics': Professor S. J. Barnett, Stanford University.

'On Gauss's Flux Theorem': Professor S. J. Barnett, Stanford University.

'The Diminution of the Potential Difference between the Electrodes of a Vacuum Tube Produced by a Magnetic Field': Dr. John Almy, University of Nebraska.

'The Discharge Current from a Surface of large Curvature': Dr. John Almy, University of Nebraska.

'Experiments on a New Form of Standard High Electrical Resistance': H. C. Parker, Columbia University.

'Variation of Contact Resistance with Change of E.M.F.': H. C. Parker, Columbia University.

'On the Demagnetization of a Discharge in Iron when Electromagnetically Compensated': Zeno Crook, Lincoln, Nebraska.

'On the Forces produced on Adjacent Spherical Surfaces by the Flux of a Viscous Fluid': S. R. Cook, Lincoln, Nebraska.

'On the Determination of Dispersion by Means of Channeled Spectra with the Concave Grating': P. J. Antes, University of Nebraska.

'On the Faraday Effect during Hydrolysis of Ferric Chloride': F. G. Bates, University of Nebraska.

'The Absorption and Dispersion of Fuchsin': W. B. Cartmel, University of Nebraska.

'On Conditions controlling the Drop of Potential at the Electrodes in Vacuum Tube Discharge': Professor C. A. Skinner, University of Nebraska.

'The Influence of Temperature upon the Photo-electric Effect': Professor John Zeleny, University of Minnesota.

'On the Resolution of the Faraday 'Effect' in the Case of Liquids': Professor D. B. Brace, University of Nebraska.

'On the New Method of determining the Curve of Luminosity by Homogeneous Comparisons': Professor D. B. Brace, University of Nebraska.

SECTION OF BIOLOGY OF THE NEW YORK ACADEMY OF SCIENCES.

AT a regular meeting of the Section held on May 13, Professor C. L. Bristol presiding, the following program was offered:

R. WEIL: 'A Contribution to the Problem of the Ear-Bones.'

A. G. MAYER: 'On the Variation of Snails of the genus *Partula* in the Valleys of Tahiti.'

O. S. STRONG: 'A Case of unilateral Atrophy of the Cerebellum.'

Dr. Weil's paper was a critical discussion of the theory of the ear-bones, as embodied in the recent articles of Kingsley and Gaupp. Two main contentions were considered: first, that the malleus and incus of mammalia were homologous with the quadrate and articular of lower forms, while the temporo-maxillary articulation is a new formation; second, that the ossicles of mammalia cannot possibly have de-

scended from those of Sauropsida. The first contention is based upon the embryonic connection of malleus and incus with the Meckelian bar, upon the embryonic situation of the last anterior to the Eustachian tube, and upon the innervation of the muscle of the malleus by a branch of the trigeminus. Embryonically, however, the malleo-incudal complex, in addition to its continuity with the Meckelian bar, arises from the auditory capsule, which contributes to both malleus and incus, the stroma of the tympanic cavity, contributing to the manubrium mallei, and a membrane bone which forms the Fallopian process. Furthermore, as Gegenbaur points out, the continuity of malleus and incus, if they be the quadrate and articular, is itself in contradiction to the independent embryonic origin of these elements in the lower forms. The pre-trematic origin of the ossicles in the pig, as described by Kingsley, is contrasted with their post-trematic, or hyoidean, origin in lower forms. Dr. Weil stated that his studies of a full series of pig and opossum embryos did not enable him to decide whether the malleus, and still more, the incus, lay primarily in front or behind the tube. The bones cross the anlage of the tube in a transverse direction, lying above it; by the gradual absorption of the intervening stroma they come to occupy the cavity of the tympanum. Finally, the innervation of the tensor tympani muscle of the malleus by a branch from the otic ganglion of the trigeminus is taken to indicate the relation of the malleus to the mandibular arch. But lesions of the trigeminus at its root do not involve hearing, while the contrary is true of lesions of the facial. This fact would point to the origin of the above-mentioned nerve from the seventh nerve, and would make the malleus a part of the second arch. The second contention is supported, first by the difference in the embryonic relations of the bones to the Eustachian canal, an argument already considered, and second, by the differences in the relations of the chorda tympani nerve, which in Sauropsida crosses *above* the chain, and in mammalia *below* it. The speaker showed that the pathologists, from a comparison of a large number of lesions of the trigeminus and of the facial at the base of the brain, had demonstrated the exit of the chorda tympani in man with the roots of the former. But since it leaves the brain in lower forms with the seventh, its relations to bony structures are evidently not sufficiently constant to constitute a criterion of homologies. From these facts, it would appear that the homology of malleus and incus with the quadrate and articular has not yet been demonstrated.

Dr. Mayer showed that the snails in question are subjected to conditions of isolation very similar to those affecting the Achatinellidæ of Oahu in the Hawaiian Islands, occurring in valleys which are separated by comparatively barren ridges. The farther apart the valleys, the less intimate is the relationship between their snails. Although geographical isolation is probably the chief factor in determining the establishment of definite varieties, yet the differing environmental conditions obtaining in each valley may exert considerable influence.

Dr. Strong presented a preliminary report, illustrated by lantern slides, upon a case of unilateral atrophy of the cerebellum in a child which lived to the age of three years and four months. The principal external anomalies noted were the following: The left hemisphere of the cerebellum was almost entirely absent; the right olive was wanting and the transverse pontile fibers on the left side were deficient; the left half of the pons protruded more than the right; the right crus cerebri was much narrower than the left; the left restiform body was smaller than the right, and the superior cerebellar peduncle of the left side was deficient; the posterior corpora quadrigemina were asymmetrical, while the left anterior corpus quadrigeminum was apparently lacking; the median line of the fourth ventricle was curved with its convexity toward the left, and such structures of the medulla as the clava, cuneus, ala cinerea, and eminentia teres were located or extended further cephalad on the left side than on the right. Preliminary transverse sections cut at various levels through the medulla, pons, isthmus and posterior corpus quadrigeminum showed the following points: only small parts of the right olive and the left corpus restiforme were present, and there was a corresponding deficiency of the cerebello-olivary fibers; the transverse pontile

fibers on the left side were reduced, but the nuclei pontia were larger on the left side; the longitudinal pontile fibers were deficient on the right, as shown by the smaller crus cerebri of this side; the left lemniscus was the smaller, and the left superior cerebellar peduncle was reduced. Other deficiencies were noted, which, however, require further study. Full discussion of the case was postponed, as the research is as yet uncompleted.

HENRY E. CRAMPTON,
Secretary.

DISCUSSION AND CORRESPONDENCE.

THE WASHINGTON MEMORIAL INSTITUTION.

TO THE EDITOR OF SCIENCE:

A curious incongruity appears in the plan for the Washington Memorial Institution as outlined in the report on 'A National University' in the current number of SCIENCE, as well as elsewhere. The first paragraph in the platform of the new institution provides that 'it will be independent of government support or control' (p. 51). Yet the seventh paragraph assumes that the institution will depend on the governmental departments (including the Smithsonian Institution, the Library of Congress, etc.) for its facilities, or in other words for the essential part of its support; and it also provides that 'students working in government laboratories or collections will be subject to the rules and regulations there prevailing,' *i. e.*, will be under governmental control. It should be pointed out that this unfortunate incongruity is much more glaring in statement than in thought; the projectors of the enterprise merely desired to emphasize the independence of the prospective institution from direct federal appropriation. Nevertheless, the incongruity has given rise to criticism in various influential quarters; it would seem, indeed, to have been one of the factors leading to the rejection of the report made by the committee of the National Educational Association.

As a matter of fact, the publications hitherto made concerning the Washington Memorial Institution have been of preliminary character, and have emanated from committees and individuals rather than from the Institution. Accordingly, criticism might well be withheld pending the issue of official statements by the Institution itself. W J MCGEE.

WASHINGTON, D. C.,
July 13, 1901.

ROYAL SOCIETY OF CANADA. SUPPLEMENTARY NOTE.

IN the account given of the twentieth meeting of the Royal Society of Canada held in May, 1901, and published in the June 28 issue of SCIENCE, the writer inadvertently omitted to mention Professor T. Wesley Mills's paper presented to Section IV. (geological and biological sciences). The title of the paper was: 'The Anatomy and Physiology of the Brain of the Bird.' It was a continuation of a former one presented to the Society two years ago. The author outlined his plan of investigation which was somewhat extensive and which, for its execution, would require much time yet. He showed that the anatomical results would probably modify the views of conduction in the nervous centers until recently prevailing, and that the entire subject would require reconsideration in view of his own and other researches in various directions. The effects of ablation of portions of the brain on the psychic condition of birds were traced in brief outline with their general implications. This part of the subject had already been worked out by the author pretty fully, but was also being continued at the present time. Remarks were made by Professor R. Ramsay Wright, of Toronto University, by Professor E. E. Prince, Commissioner of Fisheries for Canada, Dr. F. Slater Jackson, and Dr. A. M. Mackay. H. M. AMI.

OTTAWA, July 9, 1901.

A HORNED LIZARD AT A HIGH ALTITUDE.

ON June 30, at the head of John's Cañon, Las Vegas Range, N. M., I was somewhat surprised to find a horned lizard in the uppermost part of the Canadian Zone, above 10,000 feet (the aneroid indicated 10,500, but is not quite reliable at that altitude). The species is *Phrynosoma hernandes* (Girard), and the specimen is dark gray, beneath white mottled with gray. The top of the range is Hudsonian, and no lizards are found there. T. D. A. COCKERELL.

E. LAS VEGAS, N. M.,
July 2, 1901.

SHORTER ARTICLES.

THE GEOLOGIC DISTRIBUTION OF POLLICIPES AND SCALPELLUM.

In a valuable memoir on the 'Hudson River beds near Albany and their taxonomic equivalents,' published as Bulletin of the New York State Museum, No. 42, April, 1901, Dr. Rudolph Ruedemann describes a number of variously shaped valves found in the Upper and Lower Utica Shale of Green Island and Mechanicsville, N. Y. (p. 578, pl. ii.). These he believes to 'find their homologues in parts of the capitula of the pedunculate cirriped genera *Scalpellum* and *Pollicipes*, notably of the latter. On this account the various valves have been united under the caption *Pollicipes siluricus*, in full consciousness of the enormous gap existing between the appearance of this Lower Siluric type and the next Upper Triassic (Rhaetic) representatives of these genera.' Confirmation of Dr. Ruedemann's ascription may be derived from the fact that 'the enormous gap' does not exist. Early in 1892 Dr. C. W. S. Aurivillius * published the descriptions of *Pollicipes signatus* from bed *e* (= Lower Ludlow), *P. validus* from bed *c* (= Wenlock Shale), *Scalpellum sulcatum*, *S. varium*, *S. granulatum*, *S. strobiloides*, *S. procerum*, *S. cylindricum*, and *S. fragile*, all from bed *c*, of the island of Gotland. The species of *Scalpellum* are founded on peduncles, *Pollicipes validus* is represented by a broken scutum only, but *P. signatus* is based on an almost perfect specimen. The occurrence of more than one species of both these genera in the Silurian lends significance to the diversity of form presented by Dr. Ruedemann's specimens. The ornament on his Fig. 18 most nearly resembles that of *P. signatus*, while the rostrum, Fig. 22, is also not unlike that species. Figures 16, 17, 19 may belong to more than one other species, while 24 (with which presumably 25 is to be associated) may belong to a *Scalpellum*, as Dr. Ruedemann seems to hint. In the circumstances it is specially regrettable that Dr. Ruedemann has selected no one of these specimens as the holotype of *Pollicipes siluricus*. If he does not do so soon, confusion is pretty certain to arise.

* Bihang Sveska Vet.-Akad. Handl., XVIII., Afd. IV., No. 3.

Figures 13, 14, 15, are referred to *Turrilepas* (?) *filosus* n. sp. A recent examination of the plates of that genus suggests to me that the note of interrogation is fully justified.

Aurivillius considered that *Pollicipes signatus* showed a closer approach to the Balanidæ than any other of the Lepadidæ, but he too, in ignorance of the Devonian *Protobalanus* Whitf., discoursed needlessly about the gap in the distribution. Now that the range of the Lepadidæ has been extended to the Ordovician, we may look confidently for further discoveries. We may also hope that the time has now come when even the text-books may awake to the fact that the genera *Pollicipes* and *Scalpellum* existed in Palæozoic times. It was pointed out in your own columns a year ago (Vol. XI., p. 984), and in other reviews before that. But perhaps the reviewer and the author reviewed are the only readers of a review.

My apology for insisting on this is not merely that both Dr. Aurivillius and Professor Lindström, who supplied him with the material, have unhappily passed away, but that I had the good fortune to be the discoverer of the beautiful specimen of *Pollicipes signatus*, when developing a specimen of *Gissocrinus verrucosus* from the *Pterygotus* bed of Wisby Waterfall in May, 1891. The very fragile specimen was subsequently licked into shape (no metaphor is intended) by Mr. G. Liljevall, to whom the excellent drawing of it is due. F. A. Bather.

London, June 5, 1901.

QUOTATIONS.

THE SALARIES OF SCIENTIFIC MEN IN THE EMPLOYMENT OF THE GOVERNMENT.

Within the past few years our Government has come to fully recognize the wisdom of utilizing in every way possible the results of modern science, particularly in the conduct of its internal affairs. The amount appropriated by the late Congress for scientific purposes was somewhere in the neighborhood of $9,000,000—a larger sum than is devoted by any other Government to like purposes. Yet the liberal and enlightened policy evinced by legislation of this sort has been accompanied by a short-sightedness—not to use a less complimentary term—hard to account for in a legislative body made up largely

of business men. The head of the Division of Forestry, for example, with $187,520 at his disposal, receives a salary of $2,500. If a thoroughly competent man has been secured for this important position at this ridiculously low figure the Government is, indeed, to be congratulated. As soon, however, as he shall have established a reputation he will very probably be 'lifted' by some more generous Government. This actually happened last year in the case of an officer of the Department of Agriculture who received $1,800 a year. He now holds a like position in Japan at a salary of $7,000.

If in spite of this Congressional niggardliness many very capable men be now engaged in governmental scientific work, this result has been brought about more by good luck than by good management, and the broad truth is not thereby affected that in every business, whether private or public, the higher salary appeals to the higher order of talent, with its consequence of greater efficiency in the work done. At the late session of Congress an unsuccessful effort was made to rectify this mistaken policy. It is to be hoped that another session of Congress will not pass without a further and a successful effort to readjust the salaries of all government scientists, and to fix them at figures which will at least bear a comparison with those paid for similar work by many private firms and corporations.—Philadelphia *Record*.

Two important government positions at Washington are going begging because there are no applicants for them. The reason is simple: they can be filled only by men of technical skill and scientific training, and the salaries attached to them are $1,200 and $1,400 a year, respectively. The politicians who fixed these low salaries for high-class work knew that the incumbents would be worthless for political manœuvering, and hence did not care to 'waste' much money on them. It is a rule that holds good all through the scientific side of government work.—Philadelphia *Ledger*.

THE NATIONAL UNIVERSITY PROJECT.

THE action taken at Detroit by the National Educational Association on the subject of the projected national university leaves that matter in a peculiar but not a necessarily disappointing status. A committee of the Association had investigated the general project of utilizing, for higher university education, the facilities afforded by the governmental establishment and appurtenances at this capital. It reported in favor of the plan recently proposed by the George Washington Memorial Association and the Washington Academy of Sciences for the creation of an establishment to be known as the Washington Memorial Institution, to direct the energies of students desiring to avail themselves of the educational facilities here, without endowing a specific educational organization. The association declined to adopt this view and passed resolutions declaring its unwillingness to abandon its favorite project of establishing a distinct national university in this city.

Thus it appears that the issue at Detroit is between two plans to accomplish the same purpose. There is no division on the score of the desirability of utilizing the exceptional educational advantages of the capital city. All the educators agree that here lie chances for higher education which are not to be found elsewhere and which could not be duplicated with any expenditure. The majority of the delegates to the convention believe, as have many leaders of pedagogic thought in the past, and as did George Washington in the beginning, that the best way to make use of this plant is by direct means to create a university which shall stand for the national progress and prestige. Others contend that this is impracticable, and that the most promising method is to respect the existing educational establishments as sufficient in themselves and to create a supplement for the special use of those who desire a post-graduate course afforded only by the governmental facilities here.

The capital desires nothing more than that the fullest possible use be made of its exceptional opportunities for education. It hopes to see George Washington's ideal realized in some form as early as possible. It will aid to the extent of its ability any promising project to this end. It will safeguard the interests of any educational creation here, whatever its form or name. It

hopes that the discussion of the particular method whereby his object is to be attained will arouse the interest of every educator in America, and will create a determined purpose to accomplish something definite without further delay.—The Boston *Transcript*.

A NEW MAMMALIAN GENUS.

Professor E. Ray Lankester writes from the Natural History Museum, under the date of June 17, to the London *Times*, as follows:

I have this afternoon received and unpacked the case shipped at Mombasa on April 19, containing the skin and two skulls of the remarkable new giraffe-like animal obtained from the Semliki forest by Sir Harry Johnston, and sent by him to me for preservation in the Natural History Department of the British Museum. I write without loss of time to say that the specimens have arrived in perfect safety and they fully and completely bear out Sir Harry Johnston's statements and inferences.

The animal is a giraffe-like creature devoid of horns, with relatively short neck and with color stripes on the limbs, but nowhere showing spots or areolæ like those of the giraffe. Sir Harry Johnston was amply justified in assimilating the animal to the extinct *Helladotherium*, but after an examination of the skulls I am of opinion that the 'Okapi' (the native name by which the new animal is known) cannot be referred to the genus of the *Helladotherium*, but must be placed in a new genus.

I must say that, although the horny hoofs are not present, yet the double bony supports of the hoofs are preserved with the skin, and leave no doubt, even without reference to the accompanying skulls, that the animal which bore the skin was not a horse-like creature, but one with cloven hoofs.

P. S.—The 'five-horned giraffe' recently reported as having been discovered by Sir Harry Johnston is (I am told by Dr. Forsyth Major) due to a misunderstanding of a French translation of Sir Harry Johnston's description of the Okapi as 'une girafe sans cornes' (grafe à cinq cornes).

In connection with the above letter, Sir Harry Johnston has written as follows: Perhaps I may be allowed to correct a slight misapprehension that has arisen owing to a postscript attached to my friend Professor Ray Lankester's letter in *The Times* of June 18. It has been thought by the authorities of the British Museum that the telegram of a press agency from east Africa announcing that my expedition had recently discovered a giraffe with five horns was a misleading variant of the account sent some months ago as to the other discovery made by us in the summer of 1900 of the existence in the forests bordering the Semliki River of a giraffe-like animal, without horns, which has just been named 'Ocapia' by Professor Ray Lankester. Quite independently of this interesting discovery, the credit of which, it must not be forgotten, has to be shared by Mr. Karl Ericsson, of the Congo Free State, who furnished me with a complete specimen, my expedition has been the means of discovering a species or variety of giraffe, which, in the male, possesses five horn cores, instead of the two or three found in other known species of giraffe. Specimens of the five-horned giraffe were shot by Mr. Doggett and myself about five weeks ago in the country lying to the east of Mount Elgon in the northeastern part of the Uganda Protectorate. Of these specimens, two are males and two females. The female has only three horns, while both the male specimens exhibit five horn cores.

In coloration it is my opinion that this species of giraffe differs from those already known. I have in my possession now drawings and photographs confirming these statements, and the four specimens (bones of the head and neck and skins) are on their way to England for presentation to the Natural History Museum.

Until these specimens are in the hands of competent authorities it is rather premature to discuss the worth of the discovery, or the question of its substantiating the existence of a hitherto unknown giraffe.

Perhaps I may be allowed to add that the fact that a month ago my expedition was still travelling through a very wild part of the Uganda Protectorate, and was passing through enormous herds of wild game, recalling the

best days of Gordon Cumming, is indirect evidence of the rapid extension of the Uganda railway and of the remarkable facilities which it affords for travelling in a short space of time to and from London and the heart of Africa.

---

*THE NEW BUREAU OF FORESTRY.**

ON the first of July the Division of Forestry and three other scientific divisions of the U. S. Department of Agriculture were advanced to bureaus. This was provided for by the last session of Congress, which appropriated for the expenses of the Bureau of Forestry during its first year $185,440. The appropriation for the Division of Forestry during the year just ended was $88,520. For the year 1898–99 it was $28,520.

These figures show how rapidly the forest work of the Government has expanded of late, and also how well it has commended itself to Congress. There was a time when the practical value of the scientific investigations carried on by the Government was not fully understood, and farmers were inclined to think that the money spent on experiment stations and chemical laboratories was of little benefit to them. Now the case is very different. The improvements in agriculture due to the work of the Department have increased the value of the farm products of the country by many millions of dollars annually. As this kind of work has proved its practical utility, Congress has shown itself generous toward it. The readiness with which Congress has increased the appropriations for the Division of Forestry is the best evidence that forestry has proved its importance from a business standpoint.

The change from a division to a bureau, and the larger appropriation, will make possible both an improved office organization and more extended field work. The bureau will be provided with a much larger office force and will be organized in three divisions. But field work, not office work, is what the bureau exists for. This work has been going on during the last year from Maine to California and from Georgia to Washington. It includes the study of forest conditions and forest problems all over the country, the giving of advice to owners of forest lands, and the supervising of conservative lumbering operations which illustrate forest management on business principles. This work can now be greatly extended. Private owners of some three million acres have applied for this advice, which in every case requires personal examination, and about 177,000 acres have been put under management. This land is in many tracts, large and small, and is owned by individuals, clubs and corporations. Several State governments have also asked the aid of the bureau. But the greatest demand is that of the Department of the Interior of the National Government, which has asked for working plans for all the forest reserves, with the enormous total area of about 47,000,000 acres.

The Bureau of Forestry is made up of the Division of Forest Management, the Division of Forest Investigation, and the Division of Records. Each of these continues, with enlarged facilities, work which was in progress under the old Division of Forestry.

The Division of Forest Management is in charge of Mr. Overton W. Price, the former superintendent of working plans. When the owner (private or public) of woodland wishes to consider the possibilities of his property if handled as a constant source of timber supply, the tract must be examined by an expert to ascertain the condition of the standing timber, the prospects of reproduction, the facilities for marketing, the best method of harvesting the present crop so as to secure the largest present and future yield, and the likelihood of success under management. A preliminary report is then made. If the owner decides on management, a working plan follows. This involves a careful study of the rate of growth of the different kinds of marketable timber, the computation of the proper interval between cuttings and of the amount of timber to be harvested, and, if desired, the recommendation of the necessary regulations to enable the work to go on under contract. All this falls to the Division of Forest Management.

The Division of Forest Investigation, under the charge of Mr. Geo. B. Sudworth, makes studies of trees—of their rates of growth, distribution, reproduction and habits—and investigates all the forest problems connected

* Press bulletin.

with fires, lumbering, grazing, tree-planting, stream flow and erosion.

The Chief of the Division of Records is Mr. Otto J. J. Luebkert. It takes charge of all office and routine matters, and also has custody of the library of literature bearing on forestry, and of a unique collection of photographs, which is continually being added to, illustrating forest conditions all over the United States.

The result of the work of the Division has been to turn practical forestry in the United States from a doubtful experiment into an assured success. Special studies of some of the most important trees, commercially, have been made, from which can be calculated their probable future yield. Cheap methods of harvesting the present lumber crop without injuring the productivity of the forest have been put in operation. Such concerns as the Great Northern Paper Company and the Deering Harvester Company have been led to undertake conservative management of their forest properties. Meanwhile, the work of tree-planting, particularly in the almost treeless Western States of the plains, has been furthered; the relation of the forest to the volume of streams, erosion, evaporation and irrigation have been studied; matters connected with irrigation and water supply have been investigated; hopeful progress has been made in the direction of regulating grazing in the Western reserves in a manner fair both to the important interests of cattle and sheep owners and to those who look to the reserves as a source of continuous supply of wood and water; and studies of forest fires were conducted with a view of reducing the great yearly loss from this source, a loss which has been estimated at $50,000,000.

Field work is to go on this summer in 17 States. There are in all 179 persons engaged in the work of the Bureau. Of this number 81 are student assistants—young men, largely college students, who expect to enter forestry as a profession, and who serve during the summer on small pay for the sake of the experience gained.

SCIENTIFIC NOTES AND NEWS.

Professor Rudolf Virchow has been appointed a Knight, with the right to vote, of the Prussian Order 'Pour le Mérite' for Science and Art.

Trinity College has conferred the honorary degree of M.S. on Mr. John H. Sage, secretary of the American Ornithologists' Union.

Captain Scott and the other officers and the members of the scientific staff of the British National Antarctic Expedition were entertained at a farewell dinner by the Savage Club, on July 6.

The annual dinner of the Royal Institute of Public Health will take place on July 24, in London, when the Harben Gold Medal of the Institute will be conferred on Professor R. Koch, of Berlin. Lord Lister, Lord Strathcona, Professor Brouardel and other guests will be present.

F. W. Dyson, chief astronomer at the Greenwich Observatory, arrived at San Francisco on June 8, after having observed the total eclipse of the sun in Sumatra. He visited the Lick Observatory on the ninth, and intends to inspect other American observatories before his return to England.

Dr. Theo. Gill, after having attended the ninth jubilee of Glasgow University as a representative of the Smithsonian Institution and the National Academy of Sciences, is at present on the continent, where he will visit scientific institutions, including the Zoological Station at Naples.

Professor William Osler, of the Johns Hopkins University, and Dr. Edward G. Janeway, of the University and Bellevue Hospital Medical College, are among the delegates who will attend the Congress of Tuberculosis to be held in London next week.

Mr. F. H. Newell, in charge of the hydrographic work of the U. S. Geological Survey, and Mr. Gifford Pinchot, chief of the Bureau of Forestry, left Washington on July 11 for the West, having in view, among other things, the investigation of the forests and water supply of eastern Oregon. Mr. H. Gannett, of the U. S. Geological Survey, is already in Oregon inspecting the work of the various parties surveying the forests.

The Secretary of Agriculture has recently

made a reconnoissance of a portion of the area of a proposed Appalachian forest reserve designed for the protection of forests and the preservation of the water resources and soils of the Appalachian region. He was accompanied by Messrs. Gifford Pinchot, chief of the newly created Bureau of Forestry; F. H. Newell, chief of the Hydrographic Division of the U. S. Geological Survey; W J McGee, of the Bureau of American Ethnology, and J. A. Holmes, state geologist of North Carolina.

PROFESSOR O. P. PHILLIPS, of the Southern California University, is in the Pueblo region, under the auspices of the Bureau of American Ethnology, for the purpose of obtaining motion-pictures illustrating the industries, ceremonies and domestic customs of the Pueblo peoples.

DR. FRANZ BOAS, of Columbia University, received on July 1 an honorary appointment as philologist in the Bureau of American Ethnology; and under an arrangement completed just before his departure for Europe, Messrs H. H. St. Clair and W. A. Jones have taken the field and commenced the collection of several Indian languages.

As we have already stated Dr. Paul C. Freer, professor of chemistry in the University of Michigan, has received a year's leave of absence to go to the Philippines. We are now informed that he will there organize the laboratories recently established by the civil government.

DR. W. W. FORD, of McGill University, will undertake researches on some subject connected with preventable diseases under the auspices of the trustees of the Rockefeller Institution for Medical Research. He will spend the next six months at the Pasteur Institute at Paris, returning to McGill University, when the new laboratories are completed, to work under Professor Adami.

SIR ROBERT BALL, professor of astronomy at Cambridge University, will lecture in the United States during the autumn, under the auspice of Major Pond.

SIR HENRY ROSCOE, the eminent chemist, has been reelected vice-chancellor of the University of London.

SIR A. R. BINNIE has resigned the position of chief engineer to the London County Council. Under his direction many important public works, such as the Blackwell Tunnel, were carried out.

PROFESSOR A. JACOBI, New York City, has sent a notice, calling attention to the fund being collected in honor of Rudolf Virchow's eightieth birthday, to which we have already referred. The fund is to be added to that collected ten years ago, its income being used for furthering biological, anthropological and medical research. Professor Virchow will celebrate his birthday on October 13, and contributions should be in Professor Jacobi's hands not later than the first of September.

DR. ROBERT MAYER, eminent for his announcement of the law of the conservation of energy, was born at Heilbron in 1814 and practised medicine in that city until his death in 1878. The Berlin branch of the German Association of Engineers has recently placed a memorial tablet on the house in which he lived.

A BUST of Dr. Armauer Hansen, the discoverer of the bacillus of leprosy, will be unveiled with appropriate rites in the Lungegaards-Hospital at Bergen on August 10.

DR. WILLIAM H. HARKNESS, known for his contributions to entomology and botany, died in San Francisco on May 10.

WILLIS H. BARRIS, D.D., corresponding secretary and curator of the Davenport Academy of Sciences died last month in his eightieth year. Dr. Barris was professor in a theological school of the Protestant Episcopal church and was at the same time much interested in science, having published in the *Proceedings* of the Davenport Academy of Sciences numerous papers on geology and paleontology. He was a trustee of the Academy from the time of its foundation, and was elected president in 1876, and for many years acted as curator and corresponding secretary.

PROFESSOR JOHANNES LAMP, one of the scientific members of the expedition which is demarcating the boundary between German East Africa and the Congo State in the neighborhood of Lake Kivu, died on June 21 of sun-

stroke. He was for some time employed at the Geodetic Institute in Berlin, and was afterwards appointed to the observatory at Kiel, and held a professorship at the university of that city.

Dr. Axel Ericcson, the Swedish explorer, died in the interior of Africa on May 31.

It is this week reported that Mr. Andrew Carnegie has offered to give $100,000 for a library building at Leadville, Colo.; $35,000 for Alameda, Cal., and $75,000 for Coatbridge, Scotland.

Mr. T. G. Young has bequeathed £3,000 to the Technical College, Glasgow, for the purpose of establishing exhibitions in connection with the chemical laboratory.

An institute for the official examination and analysis of new drugs and remedies is to be established in connection with the Imperial Board of Health in Berlin.

The newly established Health Board for the Philippines will shortly begin to work in cooperation with the army surgeons throughout the archipelago in studying the relation of mosquitoes to malaria.

The library of the late Dr. Felix Birch-Hirschfeld, professor of pathological anatomy in the University of Leipzig, has been purchased by the Cornell University Medical College. It contains about 5,000 volumes, and cost about $10,000.

The Worshipful Company of Goldsmiths has purchased for £10,000 the library of economic literature collected by Professor H. S. Foxwell. This was done just in time to prevent the removal of the library to the United States.

Mr. George Grant McCurdy, of Yale University, secretary of Section H, Anthropology, of the American Association, has sent to members the following notice:

The Fiftieth Meeting of the American Association for the Advancement of Science will be held in Denver, Colorado, August 24–31, 1901. Dr. J. Walter Fewkes, of the Bureau of American Ethnology, will preside over the Section of Anthropology.

You are cordially invited to attend and to contribute papers upon subjects connected with your field of research.

In order that a preliminary sectional program may be distributed in advance of the meeting, titles of communications should be sent to the secretary as soon as possible. Abstracts of papers or the papers themselves may be sent later at the convenience of the authors, who are reminded that no title will appear on the final program until the paper either in full or in abstract has been passed upon by the Sectional Committee.

Excursions to points in the southwest, of special interest to anthropologists, are being planned.

The president of the Davenport Academy of Sciences, Mrs. M. L. D. Putnam, requests us to extend an invitation in the name of the Academy to the members of the American Association to visit its museum and archeological collections in going to, or returning from, Denver. Davenport, Ia., is on the Chicago, Rock Island and Pacific Railway on the direct route to Denver.

The International Association for the Advancement of Science, Arts, and Education will hold its second meeting at Glasgow, in the University and in the Exhibition, from July 29 to September 27. One of the most important functions of the meeting will again be, as at Paris last year, to study and interpret the matters of scientific, geographic and other interest afforded by the exhibition by means of lectures and conferences, with demonstrations and visits under skilled guidance.

It appears from the London medical journals that the Congress of Tuberculosis which will open in London on July 22 will be of considerable importance. Over 1,200 applications for membership have already been received, and it is expected that more than 2,000 members will be in attendance. The sum of about $25,000 has already been collected for the expenses of the meeting. The program includes addresses by Professors Koch, Brouardel and Macfadyean.

The American Philological Association held its thirty-third annual meeting at Harvard University last week with a full program. The meeting will be held next year at Union College, Schenectady, N. Y., under the presidency of Professor Andrew F. West, of Princeton University.

A civil service examination will be held on

August 20 for the position of chief taxidermist in the U. S. National Museum at a salary of $125 a month. The subjects and weights are:

Practical questions	25
Practical tests	50
Experience	25

The practical tests will comprise the submission of photographs or other illustrations of large animals or groups of animals which have been prepared by the competitor. Applicants should submit as complete and perfect representations of their work as they can secure. Applicants will be required to make sworn statements that the photographs or other illustrations submitted by them are taken from work which they executed. The position to be filled is an unusually responsible one and involves on the part of the appointee a rare combination of qualifications. He should not only have mechanical ability to execute first-class taxidermic work, but should possess the qualifications of an artist and some knowledge of the life history of animals. Applicants should have considerable experience in the preparation of large mammals, animals of the size of the grizzly bear or larger.

THE University of California has established a marine laboratory at San Pedro, as part of its proposed biological survey of the waters along the California coast.

THE new pathological institute of the London Hospital was opened by Sir Henry Roscoe, F.R.S., vice-chancellor of the University of London, July 10.

MR. JOHN LEWIS CHILDS, of New York, has purchased a large collection of birds' eggs and nests made by Mr. H. C. Parker, of Ridley Park. The collection is said to be very complete, including a specimen of the great auk's egg and other rare sorts.

MR. ABRAHAM E. SMITH, consul at Victoria, writes to the Department of State that a surveying party has located the landing site of the British Pacific telegraph cable (which is to connect the Dominion of Canada with the Australian Confederation) on Kelp Bay, near Banfield Creek, 7 miles from the entrance to Barclay Sound, and something over 100 miles from Victoria. The location is described as admirably adapted for the purpose—a good harbor, 12 fathoms of water close to the shore, so that vessels of 10,000 tons can find safe anchorage. The harbor is landlocked, and has a bottom of ooze that it is said will furnish good protection for the wire. Work has already begun in England on the cable. It is to be 5,834.5 miles in length, the longest yet constructed, and will be transported and laid in one ship, which is now being specially built for the purpose. The cable will run from Vancouver Island to Fanning Island, a distance of 3,337 miles, before a landing is effected; thence to the Fiji Islands thence to Norfolk Island, and thence to Queensland. The first instalment of cable, including the sections from Queensland to Norfolk, Fiji and Fanning Islands, is expected to leave England in January, 1902. The second and longest portion is to leave in August, 1902, come direct to Vancouver Island, and be laid from Barclay Sound to Fanning Island. According to the contract, the whole cable is to be laid and working by January 1, 1903. Unforeseen disaster excepted, those engaged in the work believe this great enterprise, which will cost $10,000,000, will be completed at the date promised.

UNIVERSITY AND EDUCATIONAL NEWS.

GENERAL A. C. BARNES, of Brooklyn, has undertaken to build and equip an astronomical observatory for Cornell University.

THE will of the late Signor Villeneuve of Montreal, leaves $25,000 to Laval University.

THE sum of about £100,000 has been subscribed toward converting University College, Liverpool, into Liverpool University.

MR. CHAMBERLAIN has asked the city of Birmingham for a contribution towards the maintenance of the new engineering buildings of the University. It appears that Nottingham contributes £7,380 a year to Nottingham College, that Sheffield gives nearly £6,000 a year to Firth College, that Leeds gives £1,500 a year to the Yorkshire College, that Manchester gives £1,100 a year, and that Liverpool gives £1,800 a year to University College, and has in addition given land worth £30,000.

As we recorded last week the National Council of Education did not adopt the report of its committee on a national university. The National Educational Association passed the following resolution, offered by President R. H. Jesse, of the State University of Missouri:

Resolved, That this Association hereby reaffirms its former declaration in favor of the establishment by the National Government of a national university devoted not to collegiate but to true university work.

THE Berkeley correspondent of the New York *Evening Post* reports that the summer session of the University opened with a registration of 720; but as some schools have not yet closed, whose teachers are to join the attendance later, the total attendance is certain to pass 800. To this body of students sixty-eight courses are offered by forty-two instructors. Last year there were 433 students and twenty-five instructors, the latter giving thirty-five courses. In 1899 there were 161 students.

THE chair of geology and natural history in the University of California, held by the late Professor Joseph Le Conte, will, it is understood, be divided, Professor Andrew C. Lawson being placed in charge of the geology and associate Professor William E. Ritter in charge of the department of zoology.

THE professorship of astronomy in the University of Missouri, which has been vacant since the resignation of Professor Milton Updegraff, to accept appointment in the United States Naval Observatory at Washington, has been filled by the selection of Dr. Frank H. Seares, of California, now studying in Paris. Dr. Seares is a graduate of the University of California.

PROFESSOR WILLIAM ESTY, of the University of Illinois, has been appointed assistant professor of electrical engineering in Lehigh University.

DR. E. C. LUNN, of the University of Chicago, has been appointed instructor in mathematics and astronomy in Wesleyan University.

PROFESSOR JAMES P. C. SOUTHALL, M.A. (Virginia), of Hobart College, New York, has been appointed associate professor of physics at the Alabama Polytechnic Institute, at Auburn, filling the vacancy caused by the resignation of Professor H. H. Kyser. Professor Southall was for three years instructor in mathematics and physics at the University of Virginia. He has been professor of physics at the Miller Institute, in Virginia, for five years, fellow and associate in physics at the Johns Hopkins University, and for two years professor of physics at Hobart College, New York.

THE usual twenty fellowships have been awarded at the Johns Hopkins University, including the following in science:

Arthur Byron Coble, of Lykens, Pa., A.B., Pennsylvania College, 1897. Mathematics.

Rheinart Parker Cowles, of Los Angeles, Cal., A.B., Stanford University, 1899. Zoology.

Charles Fowler Lindsay, of Halifax, N. S., A.B., Dalhousie University, 1899. Chemistry.

Robert Edward Loving, of Wilmington, Va., A.B., Richmond College, 1896. Physics.

Benjamin LeRoy Miller, of Oskaloosa, Ia., A.B., University of Kansas, 1897. Geology.

Louis Alexander Parsons, of Burlington, Ia., A.B., Iowa State University, 1895. Physics.

Dorothy M. Reed, of Leyden, N. Y., B.L., Smith College, 1895, M.D., Johns Hopkins University, 1900. Pathology.

Daniel Naylor Shoemaker, of Fair Haven, O., S.B., Earlham College, 1894. Zoology.

William Stone Weedon, of Baltimore, S.B., Maryland Agricultural College, 1894. Chemistry.

THE following appointments to fellowships and scholarships in physics have been made in the University of Nebraska:

Fellows: W. B. Cortmel, Case School, Cleveland; F. T. Bates, University of Kansas. Scholars: L. B. Tuckerman, Adelbert College, Cleveland; I. Summers, University of Missouri; S. Williams, Iowa College, Grinnell.

DR. ISAMBARD OWEN has been elected principal of Cardiff College in succession to the late Viriamus Jones.

THE Council of University College, Liverpool, has elected Edgar Walford Marchant, D.Sc., senior demonstrator at Finsbury Technical College (London), to the lectureship in electrotechnics vacated by Mr. Alfred Hay's appointment to a professorship at Cooper's Hill.